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Transportation, Costs and Labor in Central Peru

The Actual Cost of Mining Is Not High, but Supplies Are Expensive and Securing Title to Property Is a Tedious Process

BY J. C. PICKERING*

The advanced condition of the various mining camps and smelters of central Peru, as compared with the other districts of the country, is due in no small measure to the Peruvian Central and the Cerro de Pasco railroads, which offer a means of transportation from the principal mining districts of this portion of the Sierra to the coast, and have naturally stimulated both exploration and mining to a large extent.

The principal line connecting Callao and Lima with Oroya, the Peruvian Central, was planned by Henry Meiggs. For many years the terminus of the line was, because of political and financial troubles, at Chicla, only 141 km. from Callao, at the end of about three-fifths of the line as at present completed. In the nineties, the section connecting Chicla and Oroya was completed. The line is a single-track standard-gage railroad. Rising from Callao to Ticlio the summit, at a distance of 171 km., and an elevation of 15,665 ft., using grades up to 4½ per cent., 57 tunnels, numerous bridges and switchbacks, the line drops to Oroya the present terminus, at an elevation of 12,180 ft., and distant 222 km. from Callao.

A 120-km. extension is now being built, connecting Oroya with Huancayo, which has an elevation 10,636 ft.; this will serve as an outlet for the coal from the fields in the neighborhood of Jauja and Jatunhuasi, and will also benefit largely the important but undeveloped mining region of Huancavelica, located to the south of this extension. The first 25-km. section connecting Oroya with Huari, this latter being centrally located with respect to a promising but small and undeveloped coal district, has been completed and is in operation, and work is rapidly progressing on the next 25-km. section. It is expected that, barring political troubles, this entire 120-km. extension will be completed within a year and a half.

Preliminary surveys and locations have also been made to connect Oroya with the

CHICLA, ON THE PERUVIAN CENTRAL RAILROAD, LONG THE UPPER TERMINUS OF THE LINE

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rubber and timber country of the interior via Tarma and La Merced. It is doubtful, however, if grading will be started on this branch for some time to come, because a valuable railroad concession has been granted to A. W. McCune, of Salt Lake City, which also enters the trans-Andean country. This concession calls for a road to connect ports to the north of Callao, probably Huacho, with the timber country of the interior. One of the preliminary locations made for this road enabled it to tap the coal and metal regions of the Province of Cajatambo and to reach the interior, via Cerro de Pasco. This would probably furnish a cheaper means of transportation for the products of the Cerro de Pasco mines, than that afforded by the present roads, the distance via Huacho being 248 km. as compared with 331 km. via Oroya. The Lima papers recently published a report that a deposit of £20,000 had been made as an evidence of good faith, in compliance with one of the clauses of this concession.

The remaining branch of the Peruvian Central railroad is the 13-km. spur connecting Ticlio, the summit of the main road, with the important mining camp of Morococha.

Equipment

As regards equipment, that of the Peruvian Central is most inadequate. The locomotives weigh for the most part 40,000 lb. and are incapable of hauling more than four cars of 15 tons capacity each. Even with this load, the journey is tedious, and for freight requires from 10 to 12 hours to make the Callao-Oroya trip, or approximately 20 km. per hour. It is only recently that the trains have been equipped with air brakes. The bridges are of too light construction and the tunnels too small to admit of heavy locomotives. Estimates have recently been made for changing the motive power of the line from steam to electric current. The line is entirely incapable of handling the freight with its present equipment; the result is that all shipping points and especially the terminals are in a very congested state. Passenger trains connecting Callao with Cerro de Pasco via Oroya, run every other day. The trip to Oroya is made in 9½ hours; that to Cerro de Pasco in 14 hours.

Cerro de Pasco Line

Connecting Oroya with Cerro de Pasco, which has an elevation of 14,300 ft., the Cerro de Pasco Railway Company has built a 119-km. line. This also is a single-track standard-gage road. The location for this line did not present the difficulties which the Peruvian Central had to overcome, and the road was completed without the necessity of introducing any tunnels. One switchback was, however, employed, but I am informed that H. S. Kerr, the present superintendent of the line, intends to relocate that portion of the road, thereby doing away with this objectionable feature. From kilometer 10, measured from Cerro de Pasco toward Oroya, a 37-km. single-track spur is in operation connecting the Cerro de Pasco mines and smelter, with the company's coal mines at Vinchuscancha and Gollairisquisca.

The equipment of the Cerro de Pasco railroad is modern and in every way superior to that of the Peruvian Central road. Eighty-ton locomotives are largely employed, and I understand that 120-ton engines of the Mogul type are about to be introduced for freight service. For transporting loose ore and coal, the company employs pressed-steel cars of the gondola type, with a capacity of 60,000 to 80,000 lb. For custom freight haulage, ordinary flat and box cars are employed, with a capacity of 40,000 to 60,000 pounds.

Labor Conditions

The difficulty in securing native labor in Peru is already being felt by the large mining companies and the shortage will undoubtedly become more apparent as additional properties are opened up. The labor, which is apparently cheap, is far from satisfactory. The men are accustomed to working nine shifts per week of six days, six day and three night, which is a physical impossibility when working at full capacity. Under Peruvian management, the day shifts are 11 hours, of which fully a third is fooled away in trying to make up for the sleep lost in the previous night. The night shift is eight hours and usually about half of this time is spent in work. The man who loses is the mineowner. These customs are so deeply rooted in the minds of an ignorant people, that some time ago rioting was barely averted when a large company offered its miners six 8-hour shifts per week at 75c. (total $4.50) instead of nine 10-hour shifts per week at 50c. (total $4.50). This is merely one example of the stupidity of the native miners.

The native miner is today practically a slave of exploiting contractors. There is only one mode of procedure for securing labor. Suppose a mine requires 100 men. The company forwards $5000 to an agent or *enganchador*. This man, through the proper channels, advises miners looking for work that the mine will pay so much per shift for certain classes of labor. The miners receive an advance, generally equivalent in value to one-third of the time they are to work; thus a man bonded or "enganched" for 120 shifts at 50c. will receive $20. As security for these advances the men give their cattle, farms, etc.; two relatives or friends of means are also required to go bond.

The *enganchador* risks nothing; he usually requires that the men take the equivalent of three-fourths of their advance money in merchandise from his store at exorbitant rates, on which he makes 40 to 60 per cent. He also charges the mineowner 5c. gold per man per shift for his services. In the case above cited, of the $20 advanced, his profit in merchandise is $7; this, together with the 5c. commission of $6, makes a total of $13. The large *enganchadores* "enganch" from 3000 to 6000 men yearly. On the whole, next to highway robbery I believe this one of the most lucrative businesses in existence. The miner once "enganched" is practically a slave. For ill treatment by foreigners the native has instant redress; the authorities are only too glad to get foreigners in their power for future consideration. In the case of Peruvian management the Indian is often poorly treated, poorly paid and poorly housed. The native mineowners demand that he purchase his supplies at the mine store, where another profit of 40 per cent. is extracted, and labor is again the loser.

Mining Laws

A few remarks on Peruvian mining laws together with the usual mode of procedure for securing properties may not be out of place. The following are open for location or denouncement: (1) Deposits of minerals—coal, petroleum or fossils, which can be used for industrial purposes; (2) lands necessary for the construction of smelters, concentrators or other reduction plants; (3) water necessary for motive power or for any other use in mines or reduction works; (4) abandoned slags, washings, dumps, reduction works and the sites of old reduction works.

The following are the property of the state and are not denounceable; guano deposits, nitrate, borax and alkaline salts (subject to special laws) salt mines and deposits, and salt-water wells.

The unit of size for mining concession, i.e., one *pertenencia* or claim, measures horizontally 100 x 200 m. and has an indefinite depth in a vertical direction, with the exception of coal and petroleum deposits and placers of gold, platinum and tin which measure 200 m. on a side.

The denouncer or *locator* may apply in each denouncement for a concession comprising any number of claims not exceeding 60, but claims constituting one concession shall be grouped without interruption to form a rectangle whose sides shall be in a proportion not exceeding 10 to 1. When between two or more concessions there is a free *demasia* or fraction which does not permit the establishment of a mining claim, the owners of the adjoining claims have the preference, but if they do not care to exercise this option the ground may be secured by the first outsider making the proper application.

Every mining concession must pay an

annual tax of 30 soles ($15) for each claim or fraction thereof. The payment is made semi-annually on June 30 and Dec. 31. An owner who fails to pay his tax may do so during the following six months, but with the addition of a fine of 50 per cent.; failing to pay within this time the fine is increased to 150 per cent. during the next six months, and 200 per cent. during the third six months; after this time if the tax is not paid the claim is denounceable.

For the purpose of locating or denouncing mines the government has divided the country into districts or delegations and deputations. The offices of these delegations are situated in some town centrally located with respect to its district. The chief official at each of these offices is the *delegado,* assisted by a secretary, an expert and in the more important districts by a corps of engineers who in such cases act as experts. A denouncer of mineral property must apply in writing on government-stamped paper to the mining agency stating his name, nationality and domicile and must give the accurate location and particular features of the claim denounced (as best he can) together with a designated name, the number of provisional mining claims desired and the names of adjoining or nearest neighbors. The fee is five *soles* and the secretary's fee generally 4.50 *soles* additional. At the time of filing, the secretary notes on the margin of the petition the day and hour of filing, the number of entry in the registry of denouncements, the number of the previous entry, with name of mine and denouncer. Furthermore he records in the register the main features of the denouncement presented. The denouncement is then advertised by posters, and by publication three times in the newspaper issued at the place of residence of the *delegado* and in the newspaper of the capital of the Republic, all within 90 days.

Possession may be applied for after three months from date of acceptance of the denouncement, and before the expiration of the fifth month. After this period the denouncement is dead and open to relocation unless a three months' extension is asked for by paying a fine of 10 *soles* per month per *pertenencia.* This is rarely done, for the five months allowed by law is generally sufficient time for deciding whether or not it is desirable to take possession. The same person may not denounce the same ground twice.

Taking possession of a piece of property consists in going to the ground accompanied by the *delegado,* his secretary and an expert. The proper formalities having been gone through the act of possession is drawn up and signed. The principal item to be considered in asking possession, is the distance from the delegation's headquarters, as heavy mileage fees are charged by all those officiating. For distances of five miles, the cost of taking possession of five claims would be close to $80; at 50 miles, this would be from $175 to $225, depending on the mode of travel. All surrounding mineowners are invited to be present at their own expense, but in isolated regions the interested party generally entertains all those attending. After possession has been given the titles and all papers are sent to the capital (Lima) for approval; after which they are entered in the *Padron General de Minas,* a register published semi-annually. This generally takes two years. All opposition must be presented before the titles are approved; after this, recourse must be had to the courts.

Mines which are entered in the *Padron,* but which are denounceable for lack of payment of taxes, may be denounced at a cost of 20 *soles* per *pertencia.* Such claims do not require repossession; it is merely a change in ownership. For the protection of mineowners, no employee may locate a mine, except in places situated at a distance of more than 10 km. from the nearest point of the property of said employers.

Copies of the Peruvian mining code may be obtained in Spanish, with the English translation on the opposite page at La Opinion Nacional, Calle Gremios, No. 441, Lima, Peru; price 2 *soles* ($1).

Various pamphlets of value on the mining regions of Peru are published in Spanish and may be obtained free by applying to the Director del Cuerpo de Ingenieros de Minas, Lima, Peru. About forty of these have been published to date. The only existing maps of Peru of value are those of an Italian, A. Raimondi, drawn to a scale of 1 to 500,000 and published in sections.

LLAMAS—PACK ANIMALS OF THE ANDES

ALONG THE PERUVIAN CENTRAL RAILROAD

The *Padron General de Minas* gives lists and details of all registered mines, covering 250 pages of large size; price 2 *soles.* It may be purchased together with Raimondi's maps at any Lima bookstore.

F. Ducelliez describes in *Comptes Rendus* some alloys of cobalt and tin which contained 80 to 90 per cent. of the latter metal. Those containing above 85 per cent. tin resemble that metal and can be cut or hammered, while those containing less than 85 per cent. are hard and brittle.

George Urbain of the Paris University, claims to have discovered a new metal, says the *Scientific American,* by separating the element ytterbium into two parts. He calls the new element lotherium.

Quincy Mining Company

The report of the Quincy Mining Company for the calendar year 1907 states that the product of the mine in 1907 was 31,339,170 lb. of mineral, yielding 19,796,058 lb. of refined copper, for which was realized $3,717,501. The mining expense was $2,012,085; smelting, transportation, etc., $164,289; total, $2,176,374. This left a balance of $1,541,127, from which $55,276 taxes, paid in Michigan, was deducted, leaving a mining profit of $1,485,852. Added to this are interest and Hancock real estate receipts, amounting to $21,521, which brings the balance to $1,507,372. The following items were deducted from this total: Construction cost of mine, $183,700; construction cost at smelting works, $16,740; explorations, etc., $10,260; total, $201,700. The business profits for 1907 were, therefore, $1,295,672.

It appears from the above that the copper cost for operating expenses was 11c. per lb. Including construction, taxes and all other expenses, the cost was 12.13c. The report does not state the number of tons hoisted and milled, but if it may be assumed that the ore averaged as well in 1907 as it did in 1904, when the output was given at 307 lb. per fathom, or 17 lb. per ton, the cost per ton for the past year would be as follows: Mining and milling, $1.90; construction, 19c.; smelting, refining and marketing, 15c.; total, $2.24. This is a very good operating showing.

The report contains the following interesting statement:

The expenditure on location, previous to 1856, was $42,098; on the Quincy vein, 1858, not now worked, $55,000; for openings and explorations on 3800 ft. Pewabic vein, extending to Portage lake, preparatory to future work, $11,500; real estate and permanent improvements, including dwelling houses, stamp mills, machinery, steam engines, railroad, dock, warehouse and other buildings and roads, $6,145,931; mining and surface labor, expenses of smelting and marketing copper, and all incidental expenses, $36,981,936; balance carried down, $18,223,669; total, $62,223,669.

The receipts were: From capital stock paid in, $200,000; capital stock (scrip), $1,250,000; capital stock, 10,000 shares increase, $700,000; proceeds of copper and silver (392,274,045 lb. copper), $59,363,648; interest, $371,635; profit on sale of P. L. & R. Improvement Company stock and other investments, $79,637; sales, real estate, Hancock, Mich., $258,749; total, $62,223,669. The balance of receipts over expenditures was $18,987,204, from which was deducted dividends Nos. 1 to 82, inclusive, $17,955,000, leaving a total balance of $1,032,204.

From the above statement it appears that Quincy copper has cost 11c. per lb. for total expenditures throughout the entire life of the mine, and 9.42c. per lb. for operating alone. From a table in Steven's "Copper Hand Book," it appears that the average yield of fine copper per ton for the period has been about 30 lb. On this basis the total production of the mine to date has been about 13,000,000 tons. The total cost for operating has been $2.85, and for all expenses, $3.31.

Although the figures for the year 1907 appear sufficiently good to most persons, the superintendent, Charles L. Lawton, rather apologizes for the high costs in the following paragraph:

"Many reasons have conduced to increase the cost of the production of copper at the mine, among which may be cited the greater depth of the workings, the subterranean disturbances, the lessening of contents of metal in the rock, due to increased amount of lower-grade rock that it has been found profitable to stamp; to narrower mineral lodes being worked, and to the higher cost of labor, material, and all supplies. This rendered it necessary that a large amount of expenditures should be incurred, along the line of construction account, in order to secure such additions to the plant, repairs, alterations and improvements in the equipment as would insure a more economical working in other directions, to the end that a profitable outcome should crown our efforts. The year has thus been a strenuous one, and the work of strengthening the mine plant in its entirety has been carried on unremittingly, and in corresponding degree will continue to prevail during the year to follow."

After enumerating a number of improvements to the plant and machinery he continues as follows:

"Operations underground have been very expensive, made necessary on account of the measures taken to abate the air-blast condition and disturbances; but while expensive and at times very difficult, they seem to have been along beneficial lines, for very little trouble has been caused by air-blasts during the year.

"There is still much to be accomplished, yet the results of the steps already taken appear to be of a permanent nature and encourage us to view the future with increasing confidence.

"Nearly one-quarter more development work was done during 1907 than in the previous year, and that also was larger than was accomplished during 1905. The extra amount represents, in lineal feet, a distance greater than one mile of underground workings; the shaft sinking accomplished was three times greater than in 1906. All development underground has opened satisfactory copper-bearing ground of about the usual quality, producing the largest tonnage ever sent to the stamp mills during one year, increasing the percentage of mass over 70 per cent., and augmenting the reserves so that they are now larger than at any time of the mine's existence.

"The Mesnard-shaft territory is developing about as expected. Drifts from the shaft, with good showing of copper-rock, are well into the Pontiac territory where, by another year, raises will be commenced on the line of the Pontiac shaft.

"Notwithstanding that the great increase of expenses in all things during the year added to the average cost of a pound of copper, there are evidences of greater efficiency and economy in many directions that are well worth considering.

"The cost of coal per ton was again higher than last year, yet the decrease in consumption per ton of rock stamped shows a total saving of 9636 tons during the year, an amount greater than 10 per cent. of our entire consumption. It is reflected in a reduction of cost per lineal foot of development, helping also to reduce the cost of hoisting a ton of rock which was the lowest ever reached.

"The rockhouse changes have resulted in giving an average low cost for the year never before reached, while the average cost of stamping a ton of rock is the lowest in the history of the stamp mills, especially at No. 2 mill, where such favorable results were obtained as to make it desirable that No. 1 stamp mill be given a like advantage.

Upon ground covered with dredge tailings, according to the *Min. Journ.*, Jan. 25, 1908, one of the dredging companies of the Bright district, Victoria, has planted walnut and fruit trees. The trees are growing healthily and give promise of doing well. It is to be hoped that this experiment will succeed and that the dredging company may in its old age flourish from the proceeds of its fruit farm.

In Denmark and the Danish possessions, at the present time, the unit of weight is the Danish pound, equal to 1.1023 lb. avoirdupois; the unit of capacity is the *pot*, equal to 2.0411 American pints, and the unit of length is the *alen*, equal to 24.7125 in. At the last session of the Rigsdag a law was enacted for the adoption of the metric system in Denmark.

It is often necessary to examine an abandoned shaft, in which timbers appear too insecure to bear the weight of a man. By means of a mirror, on a bright day, sufficient light can be reflected down the shaft to enable observation to the depth of several hundred feet.

In the Siemens-Ilgner system of electric hoisting, a motor-generator having a heavy fly-wheel is placed between the main-feed wires and the hoist. Thus large fluctuation in the current taken from the supply is avoided.

In Australia the bulk of the silver, lead and zinc produced comes from the Broken Hill mines.

Actual Earning Power of the Rand Mines

Corrected Working Charge Accounts Show That Few of the Transvaal Gold Mines Are Paying Investments

BY GEORGE A. DENNY*

It will be of interest to consider the items which do not appear in the costs, as usually reported by the mining companies on the Rand and to show what effect they really have upon the commercial position. In order to get a fair idea of these non-included items, I have selected the whole of the Rand mines group, as these are generally looked upon as embodying the best features of Rand practice. It is necessary to bear in mind that we are subjecting them to the test condition previously formulated—viz., that of demanding that the capital expenditure should be recouped within a period of 10 years, accumulating at the rate of 3 per cent. compound interest, and payment of interest for the use of the money at the rate of 8 per cent. on the invested capital, basing the figures upon the returns and dividends for the year 1906.

The mines have in most cases longer lives than ten years, but there are many factors which may interfere with regular production, which cannot be forestalled, rendering it necessary in the interests of safety, to take ten years' life as the longest desirable investment period. Apart from this, there is the discounting factor to be considered, which greatly affects the purchase value in shares of a long-life mine. A life prolonged above 10 years has serious disadvantages from the strictly investment point of view, and ought to be valued accordingly.

In the accompanying tables, the present share market valuation of the mines is not considered. The figures are taken from the published balance sheets of the various companies. The sum of the additional items of cost in Table A, taken together with the usual published figures of working cost, will, however, establish the apparent investment value of the shares.

Table A discloses some remarkable figures, and for the purposes of testing the actual value of the dividend per ton in 1906, the items of non-included charges, which the shareholder is expected to cover for himself from the dividend distributed, must be compared with that dividend, as shown in Table B. Of all these mines, the figures show that only two are able to meet the minimum engagements which our test demands; therefore the shares of all but two should, for investment purposes, be valued below par.

Table C shows that the gross yield from only three of the mines is in excess of the costs when all the charges are included. The property purchase share of the cost ranges from 2s. per ton milled in the oldest mines to 11.7s. per ton in the most recently floated companies. No commentary on the burden upon profits entailed by the vendors' shares is needed.

The same examination applies with equal force to all the mines on the field. For this purpose I do not think it is necessary to take further instances, excepting one of the Gold Fields group—viz., the Robinson Deep.

ROBINSON DEEP, INTEREST AND REDEMPTION CHARGES.

	Total Cost.	Cost Per Ton Milled.
Equipment	£ 913,000	7.3s.
Shafts and development	332,400	2.7
Property	560,000	4.5
Totals	£1,805,000	14.5s.
Dividend paid in 1906 per ton milled		16.5s.

A tabulation of the included and non-included items of cost appears as:

	Per Ton Milled.
Mining expenses	14.7s.
Reduction expenses	5.6
General expenses	1.1
Equipment (interest and redemption)	7.3
Shafts and development	2.7
Property and purchase	4.5
	35.9s.
Gross yield per ton of ore milled	42.5s.
Amount available (after par value is satisfied) for reserve, extension of plant, etc	6.6s.

As an illustration of the advantages of the early system of financing the Rand companies, the case of the Ferreira Gold Mining Company may be taken, and the cost for interest and redemption charges compared with those necessary in the case of the Ferreira Deep.

COMPARISON OF REDEMPTION CHARGES, FERREIRA GOLD MINING COMPANY AND FERREIRA DEEP.

	Ferriera. Total Cost.	(Life—7 years.) Cost Per Ton Milled.	Ferreira Deep. Total Cost.	(Life—10 years.) Cost Per Ton Milled.
Property purchase	£213,200	3.5s.	£880,000	11.7s.
Equipment	185,200	3.0	394,000	5.2
Shafts and development	53,200	0.9	122,000	1.6
Totals		7.4s.		18.5s.
Dividend per ton, 1906		22.3s. per ton milled.		25.0s. per ton milled.
Excess over charges		14.9s. per ton milled.		6.5s. per ton milled.
Gross revenue		51.5s. per ton milled.		51.1s. per ton milled.

The net result, on about the same yield, is no less than 8.4s. per ton in favor of the outcrop mine; notwithstanding the fact that because of its shorter life (three years less than that laid down for our test condition) the redemption fund operates much more heavily, namely, as to £210 per annum for each £1000 invested, against £167 in the case of the Ferreira Deep.

A study of the accompanying tabulations must convey an impression of the enormous sums of money which are non-productive in even the reputedly good mines of the Rand, and from these some idea of the relative position with regard to the many mines of poor repute may be formed. The hidden capital charges form so onerous a burden in the real working costs, that when they are added to the published working costs they prove that the dividend distributions are in the majority of cases quite inadequate to meet the demands of what we have laid down to represent par value. There is evidently an urgent need for readjustment, and the problem is in what way can that readjustment be best effected.

Rand Prosperity Only Apparent

Until recently the Rand industry has been supported by money flowing into it from outside sources, and no account being taken of the growing capital amounts in the cost of production, the output and so-called "profits" reached higher and higher levels, and a false prosperity encompassed the industry, and gave it a false feeling of security from all attack. But in the last two or three years the flow of outside capital has been gradually but surely dwindling, until it has at last, for all practical purposes, completely stopped. What results? The great prosperity of the industry is found to be largely a parasitic growth, battening upon the strength surreptitiously stolen from sources foreign to itself. It has utterly failed to prove itself self-supporting, and now presents the spectacle of fearful regular shrinkages of value, which must appal the most courageous. Complaints by the financial groups of extraneous circumstances, and pretense that the adjustment of these will right the industrial situation, are no longer sufficient to hide the true position of affairs.

Utterances by magnates, particularly before recent commissions in Johannesburg, disclose the fact that certain aspects of the situation, notably the necessity of a provision for the redemption of capital, have at last been recognized as vital to the rehabilitation of the industry's credit. But it is extraordinary to note that while the groups are plainly and fully stating the necessity for better financial methods,

Note—From a pamphlet reprinted from the London *Mining Journal*.

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they fail to apply the principle in practice to the mines they control. They announce on the one hand apparently satisfactory dividends; and, on the other, complain that unless the conditions are improved, so that the mines can increase their earnings, no prospects of profit to the shareholders can be entertained.

The fact is, the marvels of the Rand and its dividends and output have for so many years been boasted of, that the Government and the people of the country have accepted the apparent prosperity as actual, and it will now necessitate a deal of explanation to show that the boasting has been unwarranted. Railways, towns, administrations, have all been planned on the basis of the apparent prosperity. The private citizen, drawing 10 per cent. interest from his investments, has arranged his future as though such a return were permanent and that his capital was appreciating. The truth is, however, that the private citizen and the country have been living on capital; and the idea that it has been living on interest is a delusion. The depression, so-called, marks the awakening of the country and the investor to the true state of affairs, and the mine-owners are in the unpleasant position of explaining that the 10 per cent. past dividends were in the majority of cases only partial repayment of capital; that the balance of capital is to a great extent lost, seeing that there is no adequate interest forthcoming; that the railways, towns, administrations and governments are on too large and costly a scale for the country to support. Seeing this is the condition of things, only eventual good can result if the fullest candor is exercised by the groups, and no more explicit exhibition of such candor could be given than to adopt the suggestion previously made, that an extinguishing capital charge, and interest at the rate of 8 per cent. per annum, should be calculated as items of the working cost. The capital amounts to be extinguished should be at least the sums actually expended in the purchase, equipment, and development of the property. If there is no possibility of a mine meeting these demands, then the accounts will disclose the fact and the losses must be written off.

The fundamental basis of the industry is unquestionably sound. Nature has in no place laid down such vast deposits of gold-bearing material. The Rand industry is today one of international importance, and any diminution of its contribution to the world's gold supply would create acute financial difficulties. Care must, however, be taken to insure that in the future the gold output represents a reasonable margin of profit over its cost, otherwise—as it has been in the past, and still is—there is actually more currency gold absorbed in the process of production, taking all charges into account, than is realized by the sale of the output. The industry must be left to work out its own salvation, and it will soon show its ability to regain the lost public confidence. It will prove to the Government that it cannot afford to pay 2s. per ton of ore crushed for railway charges, nor bear the burden of cost of an excessively over-regulated, over-inspected, and over-statisticated regime; to the Chamber of Mines, that its grandmotherly meddling is a nuisance; to the financier, that it cannot carry the burden of £5 per share when it is only able to comfortably maintain a burden of £2; to the business administration, that it is unable to pay 1s. per ton for directors' and head office fees; to the workmen, that it cannot pay double or treble the average wage for incompetent work; to the native laborer, that it cannot employ and pay three men to do one man's work; to the merchant, that it cannot find sums for the creation of rapid fortunes out of excessive profits on goods consumed.

TABLE A. WORKING CHARGES, RAND MINES GROUP, INCLUDING CAPITAL REDEMPTION.*

	Glen Deep.		Rose Deep.		Geldenhuis Deep.		Jumpers Deep.		Nourse Mines.		Ferreira Deep.		Crown Deep.		Langlaagte Deep.		Durban Deep.	
	Total Cost.	Cost Per Ton.	Total Cost.	Cost Per Ton.	Total Cost.	Cost Per Ton.	Total Cost.	Cost Per Ton.	Total Cost.	Cost Per Ton.	Total Cost.	Cost Per Ton.	Total Cost.	Cost Per Ton.	Total Cost.	Cost Per Ton.	Total Cost.	Cost Per Ton.
Equipment	£321,000	5.0s.	£479,000	5.0s.	£455,000	5.0s.	£403,000	6.3s.	£527,000	5.3s.	£394,000	5.2s.	£512,000	5.0s.	£480,000	6.0s.	£346,000	9.0s.
Mine development & shafts	196,000	3.1	316,000	3.4	173,000	1.9	308,000	4.8	442,000	4.4	122,000	1.6	388,000	3.8	325,000	4.1	210,000	5.6
Property purchase	370,000	5.8	234,000	2.6	178,000	2.0	310,000	4.8	795,000	8.0	880,000	11.7	200,000	2.0	600,000	7.6	205,000	5.4
Working costs in 1906	.....	21.5	.....	20.9	.....	21.9	.....	26.6	.....	24.6	.....	20.5	.....	19.2	.....	23.2	.....	27.4
Total costs (works & capital)	.....	35.4	.....	31.9	.....	30.8	.....	42.5	.....	42.3	.....	39.0	.....	30.0	.....	40.9	.....	47.4
Dividends per ton 1906	.....	8.5	.....	5.4	.....	8.0	.....	....	.....	10.0	.....	25.0	.....	14.0	.....	....	.....	....

Note—The total amounts shown in the schedule are extracted from the published accounts and represent, approximately the expenditure as at December, 1906, on the items mentioned. They aggregate £10,169,000. Had the share market valuation been taken, the amount to be considered would have been £16,522,000, which would have materially increased the cost per ton shown in the table. For this reason I have taken it that no deductions need be made from the capital cost on redemption account in the case of the three companies—namely, the Geldenhuis Deep, Ferreira Deep and Crown Deep—that have returned amounts exceeding the actual cash outlay in dividends, seeing that the share market capitalization on these three companies alone is £7,000,000 in excess of their dividends.

TABLE B. COMPARISON OF ACTUAL COSTS AND DIVIDENDS, RAND MINES GROUP.

	Glen Deep.	Rose Deep.	Geldenhuis Deep.	Jumpers Deep.	Nourse Mines.	Ferreira Deep.	Crown Deep.	Langlaagte Deep.	Durban Deep.
Interest and redemption charges	13.9s.	11.0s.	8.9s.	15.9s.	17.7s.	18.5s.	10.8s.	17.7s.	20.0s.
Dividend paid	8.5	5.4	8.0	....	10.0	25.0	14.0	....	....
Result per ton	— 5.4	— 5.6	— 0.9	—15.9	— 7.7	+ 6.5	+ 3.2	—17.7	—20.0

Note—The Langlaagte Deep may pay 10 per cent. or say 6s. per ton dividend, leaving a difference of say 12s. on the wrong side. The Durban Deep may pay 10 per cent. or say 3s. 6d. per ton dividend, leaving a difference of say 16s. 6d. on the wrong side.

TABLE C. COSTS, RAND MINES GROUP, WORKING, INTEREST AND REDEMPTION.

	Glen Deep.	Rose Deep.	Geldenhuis Deep.	Jumpers Deep.	Nourse Mines.	Ferreira Deep.	Crown Deep.	Langlaagte Deep.	Durban Deep.
Mining	15.6s.	14.8s.	15.3s.	19.7s.	18.2s.	14.1s.	12.7s.	16.9s.	19.4s.
Reduction	5.1	4.7	5.1	5.8	5.3	5.1	5.3	4.2	5.5
General	1.9	1.4	1.5	1.9	1.9	1.4	1.2	1.6	2.4
Equipment	5.0	5.0	5.0	6.3	5.3	5.2	5.0	6.0	9.0
Mine development and shafts	3.1	3.4	1.9	4.8	4.4	1.6	3.8	4.1	5.6
Property	5.8	2.6	2.0	4.8	8.0	11.7	2.0	7.6	5.4
Gross cost	36.5	31.9	30.8	43.3	43.1	39.1	30.0	40.4	47.3
Gross yield per ton	32.1	29.7	32.4	29.9	36.8	51.1	33.5	29.4	30.3
Result per ton	— 4.4	— 2.2	+ 1.6	—14.6	— 6.3	+12.0	+ 3.5	—11.0	—17.0

Chrome Iron Mining and Milling in Canada

Mining Operations Are Usually Conducted in Open Pits, the Ore Being Either Shipped Crude or Concentrated on Tables

BY H. F. STRANGWAYS

The deposits of chrome ore in the eastern townships of Quebec lie in the region known as the "serpentine belt." The center of the deposits is situated approximately at the little village of Black Lake, in the township of Coleraine, but the productive region may be said to extend for a radius of about five miles from this village. All the districts from which chrome is now shipped lie within ten miles of Black Lake. The Quebec Central Railway passes through this region and none of the chrome pits is more than seven miles from the track.

Chrome iron mining was begun in this region in 1894 and up to a comparatively recent date was carried on in a very spasmodic manner. The production up to 1898 amounted to a total of only 10,000 tons, while in 1905 alone it amounted to 7600 tons, and in 1906 it had increased to nearly 9000 tons. The greater portion of the ore is shipped to the United States. Ore which is sufficiently rich to be shipped without concentration is termed "crude," and contains at least 45 per cent. chromic sesquioxide. Concentrates also are shipped and paid for according to grade. The prices paid for both "crude" and concentrate vary between $9 and $12.50 per ton, depending on the amount of Cr_2O_3 present.

Geology

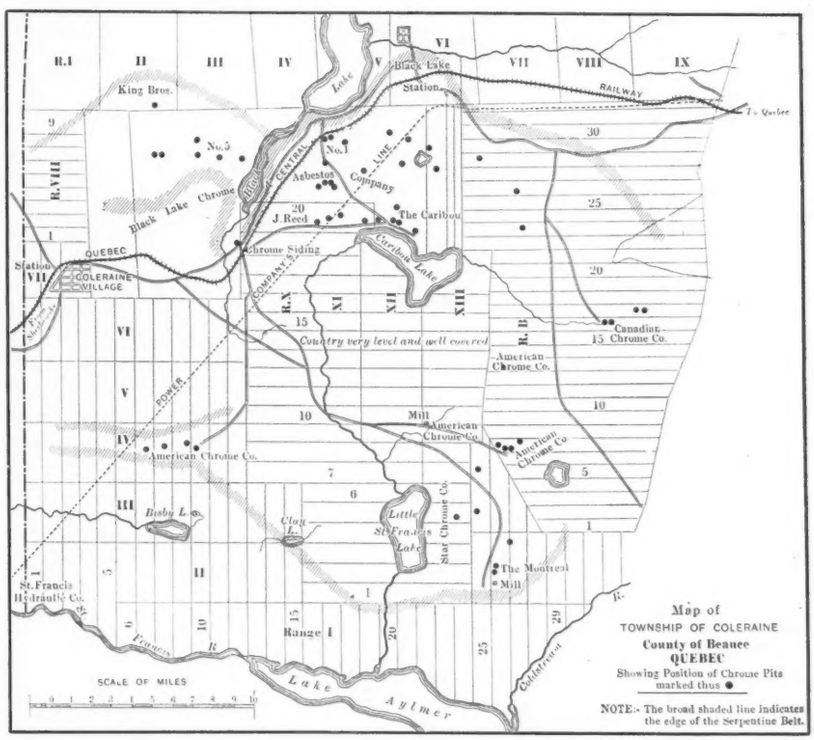
The geology of this region is rather complex and it is only necessary to state that the chrome deposits all lie in what is known as the "serpentine belt." This serpentine represents the alteration of a peridotite, which was intruded through sedimentary rocks, probably of Cambrian age.

Chromite has been found only in peridotites and allied magnesian rocks, or in serpentines which have resulted from the alteration of these rocks. It is true that there are alluvial deposits of chrome, but these can be traced back to the original peridotite rocks. The New Caledonia deposits are of this type.

Up to the present time comparatively little investigation has been made into the origin of chromite deposits. The theory set forward by Pratt, Vogt, Adams, and others is, that deposits of chrome ore, wherever found, are segregations which have crystallized out from igneous magmas on cooling. Pratt, in 1899, in speaking of the North Carolina deposits, says: "My observations have shown that large deposits of chromite occur in the peridotite rocks, near the contact of these rocks with the inclosing gneiss. Also, that where there is but a small amount of chromite, either in pockets or crystals, these are more abundant near the contact and diminish in number toward the center of the mass.

"The constant occurrence of the chromite in rounded masses of varying size near the contact of the peridotite with the gneiss, and its occurrence in the fresh as well as in the altered peridotite, would indicate that the chromite was held in solution in the molten mass of the peridotite when it was intruded into the country rock, and that it separated out among the first minerals as this mass began to cool." This theory of segregation can very well be applied to the eastern townships' deposits as regards the proximity of the orebodies to the contact.

Nearly all the pits which have been worked lie close to the contact between the serpentine and the country rock, which here is probably Cambrian. Even if the orebodies were not near the contact the irregular and pockety nature of these deposits would lead one to accept this theory of segregation. The irregularity is further accentuated by an extensive fracturing and faulting which has taken place. The ore sometimes occurs as large masses of "crude," which gradually die away or disseminate into concentrating ore and then pass to barren rock. Sometimes, however, the "crude" will separate cleanly from the barren rock without any gradual transition, suggesting a possible re-arrangement by underground waters, although in most cases in which this happens the rock face will be found to be slickensided so that this clean separation may more probably be due to the extensive fracturing and movement which has taken place, especially as such orebodies represent a line of weakness along which movement would occur.



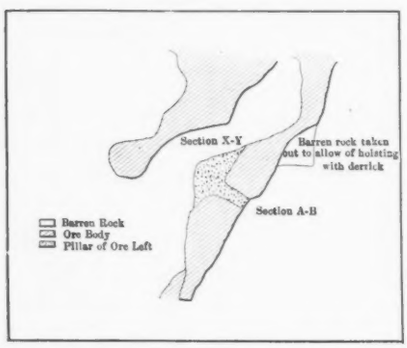
Mining

Canadian chrome ore is produced principally by three companies, the Black Lake Chrome Asbestos Company, the Canadian Chrome Company, and the American Chrome Company. Of these the first is by far the largest. In its extensive holdings the company has several chrome pits, only four of which have been worked to any great extent. These are No. 1, the Caribou, No. 5, and the Montreal. The company employs between 50 and 75 men when four pits are all in full working order.

Note—Abstract of a paper read at a meeting of the mining section of the Canadian Society of Civil Engineers, held at Montreal, Nov. 21, 1907.

No. 1 pit is the largest single chrome pit in Canada. It is admirably situated as regards transportation, power and water facilities. Power is furnished by the St. Francis Power Company at reasonable rates. The water for the mill is obtained from Black Lake, which is distant some 400 yards.

The two sectional drawings which accompany this paper will serve to give some idea of the shape and size of the orebody at this pit. Originally there were three distinct orebodies at the surface; one of these, shown to the extreme right of the section, was very small and soon pinched out; the other two were worked by an open cut to a depth of 70 ft. At this point both bodies showed signs of pinching out and the company expected to lose them altogether. The pit at the surface measures roughly 100x50 ft., which can be taken as the dimensions of the orebody at this point; at the 70-ft. level the width of the orebody is only 5 ft. However, on following this narrow strip of ore, it was found that both bodies



NO. 1 PIT BLACK LAKE CHROME AND ASBESTOS COMPANY CROSS SECTION OF OREBODIES

took a sudden pitch as shown in the section and then widened out considerably, the distance between the hanging and footwall being as much as 40 ft. in some places. A single derrick served originally to hoist the ore from the pit, but on account of the pitch this method was abandoned. After several modifications of the mining methods, made necessary by the occurrence of several accidents, the pit was considered too dangerous to be worked and about a year ago an incline shaft was sunk, starting about 40 ft. to the left of the present pit. At present the shaft is 270 ft. deep and sinking is being continued. A considerable quantity of ore had been left standing in the pit pillars and a crosscut is being driven at the 250-ft. level to extract this ore. Another crosscut will be put in at the 340-ft. level, as there is a large quantity of ore in the lower part of the pit.

Diamond-drill borings have proved the continuance of the ore below this level, and also indicate that the orebodies have taken a pitch to the left or north and east. This is indicated in the section. A new hoist, capable of handling 150 tons a day, is to be installed when the shaft is finished, and a large bin, discharging to a sorting floor under cover, has already been erected at the pit head.

Sorting

A certain portion of the ore as it is mined is sufficiently rich to be shipped; this includes all above 43 per cent. chromic oxide, and is known as "crude." This proportion varies, but the average for this pit is about 15 per cent. of the total rock hoisted. The mill waste, or concentrating ore, varies in contents of chromic oxide from 7 per cent. to 40 per cent., and amounts to about 45 per cent. of the total rock hoisted; the rest, amounting to about 40 per cent., is dump material. Nothing, roughly speaking, under 7 per cent. is put through the mill. This necessitates a certain amount of sorting. Formerly each of the two skips dumped into a bin and the ore fell from the bin onto a platform on which it was sorted. The "crude" was still further cobbed at the siding. When active operations are resumed all the ore will be hoisted from the shaft and dumped into one large bin, falling thence to a sorting floor. The material will be shoveled through holes in the floor into the tramway cars.

The Mill

The mill is situated at the siding some 1200 ft. from the pit, and a tramway connects the two. The tramway is carried on a trestle throughout its entire length; thus in winter any trouble from snow is avoided. A small double-cylinder hauling engine, with cars operated on a tail-rope system, serves to deliver the mill ore to bins in the mill, which is 85 ft. below the pit head.

The mill scheme is a simple one, being as follows:

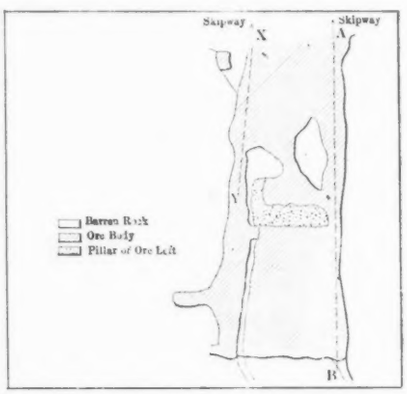
From the cars the ore is dumped into a 100-ton bin, falling thence to a 12x15 Blake crusher. From the crusher it is elevated to a shaking trough, which distributes the ore to the battery or feed bins. From the bins the ore is fed by Challenge feeders to the stamps, which, in this mill, number 30. The duty of the stamps is in the neighborhood of 2½ tons per day; their weight is 1100 lb. and the drop 8 in., which, as the dies wear, increases to as much as 15 in. The mortar has a double discharge and the screens are 20 mesh. Each battery of 5 stamps discharges its pulp directly through a pipe to a single Wilfley table, and each table makes three products—heads, middles and tails. The heads are shoveled from receiving boxes into barrels, wheeled to the concentrate shed and dumped there to drain. The bulk of these concentrates is large, amounting to as much as 15 tons a day, and two men are kept fully occupied in handling them. A drag conveyer was once installed for this purpose, but the wear and tear due to the hardness of the ore was so great that this method was abandoned.

The middles from all six tables fall into a launder and are passed thence to a separate Wilfley table which makes two products, heads and tails. These heads are of lower grade than the heads from the first 6 tables and are put through the mill again. All the tailings flow from the mill to the lake. There is a difference in level of about 250 ft. between the mill and the lake, and an electrically driven pump supplies water to the mill. The power required for the mill and machine shop is supplied by a 100-h.p. 3-phase induction motor. The machine and blacksmith shops are situated at the back of the mill.

Other Pits

The Caribou—This pit lies some 2½ miles to the south of No. 1, and a wagon road connects the two. A large quantity of "crude" of good grade has been taken from this pit, but at the present time no work is being done in it.

No. 5—This pit is situated on the west



NO. 1 PIT, BLACK LAKE CHROME AND ASBESTOS COMPANY—VERTICAL SECTION

side of Black Lake, and is not being worked at the present time, although a considerable quantity of ore has been extracted from it in the past. The "crude" from this pit is of the highest grade of any found in the district, running as high as 56 per cent. chromic oxide.

The Montreal—This pit was originally owned and worked by the Eastern Townships Chrome Iron and Milling Company. It lies about 7½ miles east of the railway, and a wagon road connects it with Chrome Siding, whence all its ore is shipped. Chrome Siding is about 1½ miles south of No. 1 pit. At present the Montreal pit and No. 1 are the only two out of the four which are being worked. The Montreal has its own mill.

Up to 1898 there had been taken from this property 3000 tons of ore, and there was every indication of its being able to furnish many times that amount. Numerous outcrops of ore from 12 to 15 ft. in thickness occurred along a length of some 300 ft., but when worked were found to pinch out.

The present company took the property

over two years ago and since that time a considerable quantity of ore has been taken out. Some diamond-drill exploration work has been done and has proved very satisfactory. The size of the body as at present developed by the borings is 400 ft. in length, with an average of 50 ft., while the thickness varies from 16 to 50 ft. There is a covering of barren rock some 50 ft. in thickness over this body. The deposit will be mined probably by a room and pillar system, although no very regular system can be employed on account of the variation in the thickness. At present two boom derricks serve to hoist the ore from the pit. The ore is roughly sorted in the pit and the large pieces of "crude" are hoisted separately and dumped at the surface in heaps to be cobbed. The boxes in which the mill waste is hoisted are lowered on small trucks and conveyed by the tramway to the mill. The barren rock is hoisted separately and dispatched to the dump. The drills, hoists and pump are steam driven, the boiler of the mill supplying the steam.

The Mill—The mill is situated on the hillside about 400 ft. from the pit and about the same distance from the lake. The scheme is the same as that at No. 1 mill. The ore is fed to a Blake crusher, falling thence to the battery bins. Fifteen stamps, in batteries of five, discharge the pulp through 20-mesh screens to three Wilfley tables. The middlings from these three tables all go to a fourth, which makes lower-grade heads and tails. These heads are re-fed to the crusher and again passed through the mill. The tailings from all the tables flow to the lake. Two 45-h.p. flue boilers supply steam for both pit and mill, the fuel being cordwood. A single-cylinder Corliss engine drives the mill and crusher.

The Canadian Chrome Company

This company's property is situated about 4 miles from Thetford, from which point all its ore is shipped. The company has opened up four small pits, all within a distance of 400 ft.; only one of these pits is being worked at present, but it is by far the largest of the four, being some 100x125 ft. at the surface and 60 ft. in depth. There is a small amount of "crude" and a considerable quantity of concentrating ore showing in the present workings. A single-cable hoist, similar to those used in the asbestos pits, elevates the ore to a tramway carried on a high trestle. One small vertical boiler supplies the steam for hoisting, pumping and drilling. All the hoisting arrangements will probably soon be changed, as the cable hoist at present used commands only a part of the pit and the steam supply is inadequate for the demands made upon it. The ore is conveyed on the tramway to the mill, dumped into a chute which feeds into a large Blake crusher, and is elevated from the crusher to the battery bins. The mill consists of 20 stamps, delivering pulp to four Wilfleys; the middles all go to a fifth Wilfley. The mill scheme is similar to that of all other mills in the district. Current is taken from the St. Francis Power Company's line to a 100-h.p. 3-phase induction motor, which operates both the crusher and the mill. The water supply for the mill is taken from a small stream about ¼ mile distant from the mill, an underground wooden pipe connecting the two.

Phosphate Mining in Florida

In an address before the Florida Bankers' Association, at St. Petersburg, Fla., on Feb. 21, C. G. Memminger, of Lakeland, stated that Florida produced during 1907 a total of 1,343,115 tons of phosphate of all classes, with a value of about $6,715,575 at the mines. The first discovery of phosphate in the State, in the form of river pebbles, was made in 1881. In 1889 hard rock phosphate was developed near Dunellon, Marion county, and shortly afterward the land-pebble deposits of Polk, DeSoto and Hillsborough counties were opened.

Florida phosphates are classed under three heads: Hard rock, land pebble and river pebble. The hard-rock deposits are included within an area approximately 100 miles long and from 8 to 10 miles wide, beginning at Fort White and extending in a southerly direction to Bay City. Florida hard rock furnishes about 80 per cent. of the world's supply of high-grade phosphate rock. It is sold under a guarantee of a minimum of 77 per cent. bone phosphate of lime and a maximum of 3 per cent. oxides of iron and alumina and 3 per cent. moisture. The entire output of hard-rock phosphate is exported, the amount shipped during the year 1907 being 591,719 tons.

Land-pebble phosphate occurs in Polk, DeSoto and Hillsborough counties. This variety represents the medium-grade phosphate which is well adapted chemically to the manufacture of fertilizers. Approximately 60 per cent. of this product is consumed in the United States, the remainder being exported. Land pebble is sold under a guarantee of 68 per cent. bone phosphate of lime and a maximum of 4 per cent. oxides of iron and alumina and 3 per cent. moisture. The production of this class of phosphate for the year 1907 was 714,702 tons.

River-pebble phosphate occurs in DeSoto county, on Peace river, and is commonly known as Peace river pebble. There has been a gradual decrease in the output of this class of phosphate, only 36,729 tons having been produced in 1907. River pebble is sold under guarantee of 60 per cent. bone phosphate of lime, 3 per cent. oxides of iron and alumina, and 3 per cent. moisture.

In view of the present output the question now naturally arises, at the present rate of production and with the certainty of a gradual increase in the future, what are the undeveloped reserves of all classes of Florida phosphate, and will the industry prove to be one of permanence? The question is answered in the affirmative. Enough data is at hand to state positively that this industry will be a source of wealth for many years.

Florida phosphate mining, especially in hard rock, has passed through many vicissitudes, but the industry today is on a sound, conservative basis and in comparatively few hands. In the hard-rock district four companies produced the bulk of the rock; in the pebble district eight companies were operating on Jan. 1; in the Peace river district only one company operates.

Seven Troughs District, Nevada

By George D. James*

The Seven Troughs district in Humboldt county, Nev., is indefinite in extent, for the name is used to designate a region through which ore-deposits are scattered. It extends from Rosebud southward beyond Vernon, and is about 30 miles long by four miles wide. The district includes the camps of Vernon, Mazuma, Seven Troughs and Farrell. Vernon is the main town.

The best way to go to the district is to leave the Southern Pacific railroad at Lovelocks and then take a stage or automobile from there to Vernon, a distance of 28 miles over good roads.

The country rock in the district is mainly rhyolite and andesite, but occasional outcrops of diorite, granite and quartz occur. The hanging wall of most of the veins is a yellowish white porphyry, while the footwall is generally diorite, called in the camp "black porphyry."

At a depth of about 490 ft. in the Fairview mine good ore has been found. This is the deepest mine in the camp. Considerable ore, assaying $300 to $400 per ton in gold and silver, has been shipped from the district. Specimens have been found that assay as high as $100,000 per ton in gold and silver. Almost all the ore now being mined is oxidized. The ore is mainly a gold ore, although in some of the ore there is considerable silver.

The camp is young, but from the development already done it appears to have a promising future.

The Government a few years ago tested the concrete work in the locks and dams on the Ohio river by means of 1¾-in. core samples taken from the work by means of core-drills. B. G. Cope (*Manufacturers' Record*, Jan. 30, 1908) suggests that this method of testing the workmanship in concrete structures be used more frequently.

*Mining engineer, Reno, Nevada.

Mineral Production of Canada

Production of Canadian Mines and Quarries in 1907 was $86,183,477. Three Times That of 1897 and Eight Times That of 1887

SUMMARY OF OFFICIAL REPORT

The preliminary report of the mineral production of Canada in 1907, as prepared by John McLeish, statistician, under direction of Dr. Eugene Haanel, director of mines, gives the following statement for the year:

MINERAL PRODUCTION OF CANADA IN 1907

Product		Quantity.	Value.
METALLIC.			
Antimony ore	Tons.	2,016	$ 65,000
Copper	Lb.	57,381,746	11,478,644
Gold		.....	8,264,765
Iron ore (exports)	Tons.	25,901	45,907
Pig iron from Canadian ore	"	107,599	1,982,307
Lead	Lb.	47,565,000	2,532,836
Nickel	"	21,189,793	9,535,407
Silver	Oz.	12,750,044	8,329,221
Cobalt, zinc, and other metallic products		.....	200,000
Total metallic		.....	$42,434,087
NON-METALLIC.			
Arsenic (refined)	Lb.	660,080	36,210
Asbestos	Short tons.	62,018	2,482,984
Asbestic	"	28,519	22,059
Chromite	"	7,196	72,901
Coal	"	10,510,961	24,560,238
Peat	"	50	200
Corundum	"	1,892	177,922
Feldspar	"	12,584	29,809
Graphite	"	579	16,000
Grindstones	"	5,382	46,876
Gypsum	"	475,508	642,470
Limestone for flux	"	359,503	298,097
Mica	"	.....	333,022
Mineral Pigments—Barytes	"	2,016	4,500
" " " Ochers	"	5,828	35,570
Mineral water	Gal.	250,985	110,524
Natural gas		.....	748,581
Petroleum	Bbl.	788,872	1,057,088
Phosphate	Tons.	750	5,514
Pyrites	"	39,133	189,353
Salt	"	72,697	342,315
Talc	"	1,534	4,602
Tripolite	"	30	225
Total non-metallic		.....	$31,217,060
STRUCTURAL MATERIALS AND CLAY PRODUCTS.			
Cement—natural rock	Bbl.	5,775	4,043
" Portland	"	2,368,593	3,374,828
Flagstones	Sq. yd.	3,000	2,550
Sands and gravels (exports)	Tons.	298,095	119,853
Sewer pipe		.....	1,211,000
Slate	Squares.	4,335	20,056
Building material, including bricks, building stone, lime, &c., estimated on the basis of production in 1906		.....	7,500,000
Total structural materials and clay products		.....	$12,232,330
Estimated value of mineral products not returned		.....	300,000
Total, 1907		.....	$86,183,477

Of the gold reported $3,150,000 came from the Yukon, and $5,114,765 from other provinces and territories. The returns for silver, copper, lead and nickel include metallic contents of ore and matte exported. The metals, copper, lead, nickel and silver, are, for statistical and comparative purposes, valued at the final average of the refined metal in New York. Pig iron is valued at the furnace, and non-metallic products at the mine or point of shipment. The total production of pig iron in Canada in 1907 was 651,962 short tons, valued at $9,125,226, of which it is estimated about 107,599 tons valued at $1,92,307 should be attributed to Canadian ore, and 544,363 tons, valued at $7,142,919 to the ore imported.

The chief increases, as compared with 1906, were in coal, silver, nickel, copper, asbestos and petroleum. The important decreases were in gold and lead. The proportions of the more important products to the total were: Coal, 28.5 per cent.; copper, 13.3; nickel, 11.1; silver, 9.7; gold, 9.6; lead, 2.9; asbestos, 2.9; pig iron from Canadian ore, 2.3 per cent.

The annual production for 22 years past has been valued as follows:

ANNUAL PRODUCTION FOR 22 YEARS

1886	$10,221,255	1897	$28,485,023
1887	10,321,331	1898	38,412,431
1888	12,518,894	1899	49,234,005
1889	14,013,113	1900	64,420,983
1890	16,763,353	1901	65,804,611
1891	18,976,616	1902	63,211,634
1892	16,623,415	1903	61,740,513
1893	20,035,082	1904	60,073,897
1894	19,931,158	1905	69,525,170
1895	20,505,917	1906	79,057,308
1896	22,474,256	1907	86,183,477

The comments of the Mines Branch on the results of 1907 are given in substance below.

General Remarks

The early months of 1907, and even well along past the middle of the year, were marked by great activity in all branches of commerce and the mining industry shared with other commercial undertakings, the beneficial results of increasing prosperity. The outlook was for a mineral production far beyond all previous records. But excessive prosperity brought about its own depression, since within a few months of the close of the year, a rapid change took place. Whereas before, the transportation companies were unable to take care of the business offering, work was so plentiful that labor became scarce and high in price, the demand for commodities so great, that in the case of the metals, prices rose to figures seldom before reached; in one short month exactly the reverse conditions were in evidence; railway cars became idle for want of freight, laboring men were glad to accept reductions in pay and keep their jobs, and the prices of the metals fell with rapidity. Fortunately, however, for us in Canada, the financial stringency has not had such serious results as with our friends across the border, and although some of our mineral industries found it necessary to cease operations, some of these have already resumed, and the great body of the mining industry still continues to enjoy a conservative and steady progress. Fortunately, also, this change of conditions occurred too late in the year to affect seriously the expected increase in mineral output. Thus it is that we are enabled to record a substantial increase of over 9 per cent. in the mineral production in 1907 as compared with 1906. The total value of output, valued according to the methods adopted in this branch since its inception, was about $86,183,477, the largest output the Canadian mining industry has yet attained.

Gold

A large decrease in gold production—over 28 per cent.—represents a falling off in every district, except Nova Scotia. Four years ago gold was relatively the most valuable mineral product in Canada, but in 1907 it has fallen to fifth place. A continual shrinkage has taken place in the output of the Yukon from $22,275,000 in 1900, to about $3,150,000 in 1907. The effect of this shrinkage was to some extent lessened by the continued increase from British Columbia, but in 1907 this province also shows a falling off both in placer and lode output, a decrease of over 13 per cent. Less than half as much gold

was obtained from the Yukon in 1907 as in 1906. Of the total gold output in 1907, about 47 per cent. was obtained from placer and hydraulic workings, and 53 per cent. from ores.

Silver

About 12,750,044 oz. of silver were contained in ore shipments in 1907 as compared with 8,473,379 oz. in 1906, an increase of over 50 per cent. Over 99 per cent. of the production in 1907 was derived from the provinces of Ontario and British Columbia, and about 77 per cent. from the Cobalt district of Ontario alone. The rapid development of the Cobalt district has brought the Province of Ontario to the front as a silver producer, and although complete returns have not yet been received from the smelters, close estimates have been made by the mine owners. Returns from 24 shipping mines show the ore shipped as approximately 14,557 tons, containing 9,914,056 oz. silver. At the average price of refined silver, for the year, this would be worth $6,476,555 and it represents an average return of 681 oz. silver, or $444.87 per ton of ore shipped. There was a slightly smaller output of silver in British Columbia in 1907, a falling off of probably about 200,000 oz. It may be noted that there was a larger amount of silver in ore, etc., entered for export than the records of production show, the excess being over 2,000,000 oz. The exports for the 12 months, according to the customs department returns, were 14,813,735 oz. valued at $9,941,849.

Copper

An increase is shown in copper output, a decrease in British Columbia being more than offset by an increase in the copper content of the Sudbury nickel-copper ores. The aggregate production of copper, 1907, was about 57,381,746 lb., an increase of 3 per cent. over 1906. The copper mines of the Boundary district of British Columbia, as well as others in the Nelson and Coast districts, were closed down in November, and although some of them resumed again after a few weeks, the total output for the province was somewhat less than in 1906. This decrease, however, has been more than met by the increased output of copper from the Sudbury ores of Ontario (see under nickel). Of the total production in 1907, over 72 per cent. was obtained from British Columbia mines, and 19 per cent. from Ontario. The total exports of copper in ore, matte and other forms were, according to customs department returns, 27,194 tons.

Lead

All the production recorded was mined in the province of British Columbia. The output is less than that obtained in 1906 by nearly 13 per cent. A considerably less tonnage was shipped from East Kootenay mines, with probably an increased output from West Kootenay. No bounty was paid during 1907 on lead ores, but in December the price of lead had fallen to a point at which bounty could be claimed. The exports of lead in ore, during the year were 10,989 tons, and of pig lead, etc., 1807 tons, or a total of 12,796 tons.

Nickel

With the exception of the nickel contained in the ores shipped from the Cobalt district, the production of nickel in Canada is derived entirely from the well known nickel-copper deposits of the Sudbury district. The output has been increasing steadily for a number of years, although the actual amount of nickel contained in matte shipped in 1907 is somewhat less than in 1906. Two companies are carrying on active operations: The Mond Nickel Company, at Victoria Mines, and the Canadian Copper Company, at Copper Cliff. The ore is first roasted and then smelted to a matte containing from 77 to 80 per cent. of the combined metals, copper and nickel, which is shipped to the United States and Great Britain for refining.

The following were the aggregate results of the operations on the nickel-copper deposits of Ontario in 1906 and 1907 in tons of 2000 pounds:

	1906.	1907.
Ore mined	343,814	351,916
Ore smelted	340,059	359,076
Bessemer matte produced.	20,364	22,041
" " shipped..	20,310	22,025
Copper contents of matte shipped	5,265	6,996
Nickel contents of matte shipped	10,745	10,095
Spot value of matte shipped	$4,628,041	$3,289,382
Wages paid	1,117,420	1,278,694
Men employed...Number.	1,417	1,660

According to customs returns exports of nickel in matte, etc., were for 12 months ending Dec. 31, as follows, in pounds:

	1906.	1907.
To Great Britain	2,716,892	2,518,338
To United States	17,936,953	16,857,997
Total	20,653,845	19,376,335

The above figures of nickel production do not include the nickel contents of the silver-cobalt ores from Cobalt district, complete statistics of which have not been obtained by this department. The shippers of silver-cobalt ores receive practically no returns for the nickel contents, although these amounted in 1906 to about 3 per cent. of the ore shipped, according to returns compiled by the Ontario Bureau of Mines.

No official statistics regarding zinc-ore production in British Columbia are to hand, and the zinc smelter at Frank, Alberta, has not been in operation during the year. A few tons of zinc ore were mined in Ontario.

Iron Ore, Iron and Steel

The total shipments of iron ore from mines in Canada, in 1907, were 310,996 short tons, valued at the mine at $662,441, as compared with 248,831 tons, valued at $589,206 in 1906. Of the total shipments in 1907 there was shipped to destinations in Canada 283,543 tons, and to the United States 27,453 tons.

The total production of pig iron in Canada in 1907, from both Canadian and imported ores, according to direct returns from nine companies operating 16 furnaces, was 651,962 short tons, valued at $9,125,226, an increase of nearly 9 per cent. in quantity over the amount made in 1906. These figures do not include ferro-products made in electric furnaces. Of the total output of pig iron last year 10,047 tons were made with charcoal as fuel, and 641,915 tons with coke. The amount of Canadian ore, including mill cinder, etc., used was 244,104 tons, while the quantity of imported ore used was 1,117,260 tons. The total amount of coke used during the year was 847,150 short tons valued at $3,383,223, of which 520,068 tons, valued at $1,652,125, was made in Canada, and 327,082 tons, valued at $1,731,098, imported from the United States. The quantity of limestone flux charged was 498,462 tons.

Returns from seven companies making steel showed a total output during the year of ingots and castings of 706,982 short tons, valued at $16,612,590. Of this amount, 685,229 tons were ingots, and 21,753 tons castings. Of the ingots made, 225,989 tons were bessemer steel and 459,240 tons open-hearth. All of the castings, with the exception of 1151 tons, were open-hearth steel.

Following is a statement of the bounties paid on iron and steel during the calendar year 1907, as kindly furnished by the trade and commerce department:

	Quantity. Tons.	Bounty.
Pig iron, made from Canadian ore	95,915	$201,421
Pig iron, made from imported ore	537,803	591,584
Total pig iron	633,718	$ 793,005
Steel ingots	666,590	1,099,873
Steel wire rods	68,738	412,417
Total bounty paid on iron and steel		$2,305,295

Asbestos

Returns of shipments of asbestos from the Eastern Townships, province of Quebec, were received from 12 operating companies, who employed about 2175 men in mines and mills and paid in wages $840,684. In addition to these four other companies were making extensive preparations for active mining and milling in 1908. The total shipments divided into crude and mill stock were, in 1906 and 1907, as follows, in tons:

NO. 2. SHIPMENTS OF ASBESTOS FROM CANADA IN 1907.

	1906		1907	
	Tons.	Value.	Tons.	Value.
Crude	3,793	$ 626,895	4,338	$ 830,632
Mill stock	55,490	1,343,983	57,680	1,652,352
Total asbestos	59,283	$1,970,878	62,018	$2,482,984
Asbestic and asbestic sand	20,127	17,230	28,519	22,059
Total products	79,410	$1,988,108	90,537	$2,505,043

Exports of asbestos, according to Customs returns were:

	Tons.	Value.
Twelve months ending December, 1906	59,864	$1,689,257
Twelve months ending December, 1907	56,753	1,669,299

The special features of interest regarding the industry during the year have been an increased output, higher prices realized for the product, further consolidation of mining interests, the introduction of electric power by the Shawenegan Power Company, and the continued successful working of the East Broughton district, which is chiefly a fiber producer.

Coal and Coke

Each of the coal-mining provinces contributed an increased output to the coal production in Canada in 1907. The total sales and shipments of coal used in making coke were 10,510,961 short tons, an increase of more than 7 per cent. as compared with 1906. Of the total Nova Scotia contributed over 60 per cent.; Saskatchewan and Alberta, over 16 per cent., and British Columbia, over 23 per cent. Alberta shows the largest proportional increase, 23 per cent., and British Columbia next, over 13 per cent. The production by provinces was approximately as follows, the figures being in short tons:

	Tons.	Value.
Nova Scotia	6,337,632	$12,731,850
New Brunswick	34,584	77,814
Saskatchewan	153,914	259,019
Alberta	1,534,001	3,819,587
Yukon	15,000	60,000
British Columbia	2,435,830	7,611,968
Total	10,510,961	$24,560,238

The total production of coke in 1907 was approximately 842,004 short tons, valued at $3,485,533. This is made in ovens in Nova Scotia, Alberta and British Columbia. At the end of the year there were in Nova Scotia about 654 ovens in operation and 173 idle, and in Alberta and British Columbia on the same date 850 in operation and 582 idle.

Petroleum and Natural Gas

The production of petroleum is, as usual, practically all derived from the Ontario peninsula. Direct returns from the producers have not been obtained, but the production has been estimated on the basis of the bounty of 1½c. per gal. paid by the Dominion Government. The total bounty paid in 1907 was $414,158, representing a production of 788,872 bbl., compared with a bounty of $299,120 paid in 1906, representing a production of 569,753 bbl. An increased production in 1907 of over 38 per cent. is, therefore, shown.

Natural gas was produced and sold in Quebec province in the vicinity of Louisville; in the Niagara peninsula and southern portion of the province of Ontario, and at Medicine Hat, Alberta, the sales from the Ontario fields constituting over 91 per cent. of the total. The total receipts from gas sold in 1907 show an increase of about 31 per cent. over the receipts in 1906, and are now larger than at any time since the gas was first used. About 440 wells were producing gas in 1907, of which 114 were bored during the year.

Portland Cement

Complete statistics have not yet been received, two companies having not yet been heard from. The figures given below for 1907 are, therefore, subject to correction, and when complete returns are received, will be increased by an amount probably not exceeding 4 or 5 per cent. The total daily capacity of the 15 companies making returns was about 12,400 bbl., the other two companies having a daily capacity of 1900 barrels, making a total capacity of 14,300 bbl. per day. These companies are distributed as follows: One in Nova Scotia, one in Quebec, 13 in Ontario, one in Alberta and one in British Columbia. At least six other plants were in course of construction with a total proposed daily capacity of from 10,000 to 12,000 barrels.

Of the 17 producing companies 12 use marl and clay, four use limestone and clay, and one uses blast-furnace slag. One other company, now in liquidation but with completed plant, made cement from marl. Of the six plants being erected, four at least propose to use limestone. Detailed statistics of production in 1906 and 1907 are as follows, in barrels:

	1906.	1907.
Portland cement sold	2,119,764	2,368,593
Portland cement manuf	2,152,562	2,413,513
Stock on hand, Jan. 1	269,558	299,015
Stock on hand Dec. 31	302,356	343,935
Value of cement sold	$3,164,807	$3,574,828

The average price per barrel at the works in 1907 was $1.43, as compared with $1.49 in 1906, and $1.42 in 1905.

The imports of Portland cement into Canada in 1907 were 2,354,204 cwt. This is equivalent to 672,630 bbl. of 350 lb. each, at an average price per barrel of $1.245. The duty is 12½c. per 100 lb. The imports in 1906 were equivalent to 694,503 bbl., valued at $778,706, or an average price per barrel of $1.12. There is very little cement exported from Canada.

Exports of Canadian Products

Exports of Canadian metals, minerals and structural materials from the Dominion are given by the Customs returns as follows, for the year 1907:

NO. 3. MINERAL EXPORTS OF CANADA IN 1907.

Products.		Quantity.	Value.
Arsenic	Lb.	613,504	$ 10,850
Asbestos	Tons.	56,753	1,669,299
Barytes	Cwt.	550	2,750
Chromite	Tons.	892	19,800
Coal	"	1,894,074	4,879,564
Felspar	"	12,068	37,932
Gold	.....	.....	8,029,603
Gypsum	Tons.	375,026	424,794
Copper, fine in ore, &c.	Lb.	54,651,452	8,742,133
" black or coarse and in pigs	"	36,998	7,476
Lead, in ore, &c.	"	21,978,177	865,941
" pig, &c.	"	3,613,706	163,957
Nickel, in ore, &c.	"	19,376,335	2,280,374
Silver, in ore, &c.	Oz.	14,813,735	9,941,849
Platinum, in ore concentrates, &c.	"	242	4,864
Mica	Lb.	1,117,010	422,172
Mineral pigments	"	382,624	10,043
Mineral water	Gal.	2,877	1,913
Oil:—			
Crude	"	1,125	102
Refined	"	3,132	575
Ores—			
Antimony	Tons.	1,327	37,807
Iron	"	25,901	45,907
Manganese	"	1	22
Other ores	"	11,232	428,250
Phosphate	.....	.....	.....
Plumbago	Cwt.	2,415	3,036
Pyrites	Tons.	25,056	80,139
Salt	Lb.	2,222,542	7,709
Sand and gravel	Tons.	298,095	119,853
Stone, ornamental	"	153	1,262
" building	"	225	1,825
" for manufacture of grindstones	"	460	5,154
Other products of the mine	.....	.....	190,720
Manufactures—			
Bricks	M.	802	6,193
Aluminum, in bars, &c.	Lb.	5,478,203	1,109,353
" manufactured	.....	.....	1,499
Cement	.....	.....	9,618
Clay, manufactures of	.....	.....	369
Coke	Tons.	70,617	320,357
Grindstones, manufactured	.....	.....	32,534
Gypsum, ground	.....	.....	557
Iron and steel	.....	.....	1,607,368
Lime	.....	.....	55,903
Metals, N.O.P.	.....	.....	63,700
Plumbago, manufactures of	.....	.....	2,847
Stone, ornamental	.....	.....	3,576
" building	.....	.....	657

Iron Making in Australia

By A. Selwyn-Brown

The Iron and steel imports—including machinery—of Australia and New Zealand approximate upward of $40,000,000 per annum. The chief sources of supply at present are the United States and Europe. The United States Steel Corporation and the principal European companies maintain selling offices in Australia, and there is keen competition for the trade. Since, however, the Commonwealth government has adopted a protective policy there has been a demand for the establishment of local smelters to treat local iron ore.

Australian Blast Furnaces

Last year this demand was met by William Sandford, the proprietor of a rolling mill at Lithgow, New South Wales. Mr. Sanford secured contracts for the supply of all the iron and steel required by the Commonwealth and several State governments, and by several large engineering companies, for a period of 10 years. Thereupon he built a modern blast furnace and open-hearth steel furnaces, at a cost of $1,500,000, at Lithgow, and enlarged his rolling mill. The plant, which has a capacity of 60,000 tons of pig iron per annum, was blown in on May 15, 1907, on ore from local mines, and ran steadily until last December, when, owing to the exhaustion of the working capital of the proprietor, smelting had to be suspended. This short run demonstrated, as indeed previous trials of other plants which had attempted to reduce local ores had done, that the ore is easily reduced and makes a high-grade product.

During the smelting run an expert of the Mines Department of New South Wales studied the operations, and, in a recent report, he stated that the plant was well built and efficient. He had excellent facilities for valuing the product and was well satisfied with the qualities of the iron and steel produced. In judging the pig iron he was guided as follows: (1) By the reports by the various foundries using it; (2) by the demands for the Lithgow brand in the open markets; (3) the suitability for conversion into steel at the works; (4) the chemical and microscopical analyses.

The cost of producing pig iron amounted to $10 per ton, and the profit, at local rates, was $4. The selling price in Sydney, in the open market, was $15 per ton.

Financial Difficulties

The works gave employment to 700 men and several thousand were engaged in the mines and other works directly and indirectly connected with the smelters. Out of respect for the energy and ability shown by Mr. Sandford in erecting and running the works in the face of many difficulties, the whole force employed volunteered to assist the management in keeping open the works by working two weeks without pay. Owing, however, to the large sum required to finance the operations this unusual offer could not be accepted.

The store-keepers and local merchants then joined with the labor unions and petitioned the proprietor to continue operations. After due deliberation it was concluded that an appeal should be made to the government for financial assistance. Thereupon the proprietor, and deputations representing the local residents and merchants, creditors of the works and the labor unions petitioned the government to advance the sum of $500,000 to continue smelting.

After a lively debate in the New South Wales Parliament the government decided to advance the money on a first mortgage of the plant, collieries and iron mines, provided its experts reported favorably as to the possibility of the industry being carried on profitably in the future.

The experts found, after a thorough investigation, that the proprietor was forced to close down solely on account of insufficient working capital to enable him to finance the complicated operations necessary in mining and reducing the ore, working the iron and steel into the required forms, and extending to purchasers the credits demanded in accordance with commercial customs. It was unanimously agreed that with sufficient working capital the smelting operations could be carried on regularly and profitably and that other subsidiary operations could be established that would largely assist in the development of the local mining and engineering industries. On receipt of the reports the government agreed to advance the required capital. Then one of the local banks stepped in and objected to the government taking a first mortgage on the grounds that the bank had a larger prior lien. Confronted with this objection the government was powerless to render the aid demanded, and, unless all the parties concerned can compromise, it is very probable the works will be compelled to go into the hands of a receiver. Owing to the favorable results of the initial operations of the plant, however, and the optimistic character of the expert reports regarding the profitable nature of the operations, if carried on extensively, capitalists will not permit the works to remain closed permanently. Already offers have been made to the proprietor for the plant and mines.

Direct-steel Process

For several years past Messrs. Heskett and Moore, two Victorian metallurgists, have been experimenting with a new process with the view of reducing the ore and converting it into steel in one operation. During the past two years experiments have been made at the smelting works in Melbourne with Tasmanian and New South Wales ores. From general discriptions of the plant it appears that the molten iron from the blast furnace is passed into reverberatories fired by producer gas. The chief improvement claimed for the process is in the method employed in protecting the molten metal from oxidation by a mantle of reducing gas. A company has been formed to erect a smelter on the Moore-Heskett principle at Rylstone, New South Wales.

The company is known as the New Direct Process Iron, Steel and Metals Corporation. It has purchased a tract of 6000 acres or iron and coal lands near Rylstone, N. S. W., and a rolling-mill plant at Altona Bay, Melbourne, Victoria. The construction works will be commenced very soon.

Markets for Australian Iron

The promoters of the Australian smelting works, in addition to the local demand, have always calculated on sharing the immense markets of the Orient. India, China and Japan are large consumers of all classes of iron and steel and they are all close to Australia and well connected by excellent shipping lines. At present Australia only exports machinery, scrap iron and iron ore to the Oriental markets but there is little doubt of the ability to develop an extensive trade in pig iron and steel when the local iron-smelting industries are well established. At present Japan and China are demanding increased supplies of Australian iron ores and recently a scientific commission, as a result of an exhaustive study of the iron resources of the world, recommended the Japanese government to draw the chief iron-ore supplies for its works from Australia; and arrangements are now being made by the government to adopt this suggestion.

The Flohr process, which consists of adding briquets composed of iron oxides, such as hammer or rolling-mill scale bound together by slacked lime, to the charge is being used according to *Engineering*, Jan. 10, 1908, at several basic bessemer steel plants in Germany. These briquets are added toward the end of the decarburizing period, and owing to their intense effect on the bath an after-blow of only a few seconds is required.

According to *Eng. News*, the Gunnison tunnel, which is to form a part of the Uncompahgre irrigation project, in Colorado, had been holed to a total length of 20,488 ft. at the close of 1907, of which 689 ft. was done in December.

Boiler efficiency at steam plants is greatly increased by the use of apparatus which records the percentage of carbon dioxide in the escaping flue gas. The draft can then be properly regulated.

The Use of Steel Supports in Coal Mines

Steel Props Are More Easily Handled, Have Greater Adjustability, Occupy Less Space and Are Cheaper Than Wood

BY R. B. WOODWORTH*

The rapid denudation of our forests has brought the mine operators, especially in the anthracite region, face to face with the need of finding some substitute for wood, and it is confidently believed by many that steel is the best material to take its place in the construction of gangway supports, props, etc. Now if steel is to meet the requirements of an ideal construction to take the place of wood, there are a number of conditions it must satisfy.

First and foremost, it must possess strength, and steel as is well known, lends itself to the development of any reasonable strength that may be required. For the collar of the square timber set, there is no form of section rolled more economical than the standard I-beam used in ordinary construction, but for the legs of the square mine timbers and for the props themselves, it has been apparent for some time that in the United States at least, the most economical section had not been rolled. This, however, is now given us in the H-section, a form of rolled shape which possesses a large radius of gyration and the most economical distribution of material in comparison to its weight.

The first manufacturer to furnish these in the United States has been the Carnegie Steel Company and its 4-, 5-, 6- and 8-in. sections have been devised with a view especially to their use in coal-mining operations. The 4-in. section weighing 13.6 lb. per lineal foot possesses sufficient strength to take the place of 6- and 8-in. yellow-pine timbers; the 5-in. section weighing 18.7 lb. and the 6-in. section weighing 23.8 lb. per lineal foot are of equivalent strength to 10-in. and 12-in. yellow-pine timbers, while an 8-in. H-section weighing 34.6 lb. per lineal foot will be of equivalent strength to a 15-in. round yellow-pine prop, which is about the largest size used in the mines at present.

STEEL TIMBERS ON GANGWAY IN MINE NO. 36 OF BERWIND-WHITE COAL COMPANY AT WINDBER, PENN.

Safety

The next consideration in the substitution of steel for timber is that of safety. In the anthracite region in 1906, 67 per cent. of the fatal accidents were due to falls of coal, slate and roof; in the bituminous region 53.55 per cent. It is apparent, therefore, that any substitute for wood should be of sufficient strength and of sufficient ease of application to prevent if possible a large number of such accidents. Steel answers these requirements, but its safety is not to be found solely in the prevention of accidents. A large element in its favor is its fireproof character. Unfortunately, statistics on destructive fires in the mines are not available, but steel has already demonstrated its usefulness in mines where explosions and fires have occurred, and though it is possible to displace same, it cannot catch fire. We hear frequently of fires started in the timbers by the miners' naked lamp; we hear also of fires in stables and pump-houses, and it is apparent that if steel were adopted for no other place in the mines, the stables, pump-houses, foot of slopes and shafts would still offer large fields for its usefulness from the standpoint of fire protection alone.

Simplicity

The third requirement for ideal mine construction is that of simplicity, and by reference to the illustrations, it can be noted how simple steel can be made and how it can be arranged to conform to the personal ideas of those who use it.

In the most approved form of construction for steel props, shown in the

Note—Abstract of an address made at Pittsburg, December 11, 1907, before the Coal Mining Institute of America, and prepared by the author.

*Carnegie Steel Company, Pittsburg, Penn.

first illustration, provision is made for adjustability both at the top and the bottom, pin connections being used at the top and castings at the bottom. Steel wedges are driven in at the bottom of the beam so as to distribute the weight on two pins and additional holes are provided to take up the difference in level. In this form of construction, it is necessary to assemble one beam, four fillers, two wedges, four pins and cottars, four channels, four shoe castings, six pieces of gas pipe and six bolts, making 31 pieces in all. This makes the cost of this style of timber comparatively high. It is possible to modify this form of timber by having the adjustment made by pin connections at the top and bottom, the large shoe castings being eliminated. This latter arrangement has the advantage of adjustability, but owing to difficulties in obtaining a sufficient bearing on a single pin at the foot of the legs, it is not adapted to cases where great strength is required.

ADJUSTABLE STEEL SUPPORTS, IN ONE OF THE LYKENS VALLEY COAL COMPANY'S COLLIERIES AT WILLIAMSTOWN, PENN.

Adjustability not Necessary

Observation and experience, however, and careful consideration of the whole matter would indicate that inasmuch as wooden gangway supports used in the mines are not adjustable, it is needless and uneconomical to endeavor to provide adjustability in the steel timbers which are to take their place. A simpler form of construction, therefore, is to have a single-beam collar and four channels connected by bolts and separators. In this style of construction, the channels can be connected together by bolts and pipe separators, and when the material reaches the point of erection, there will be only five pieces to take care of, a single beam collar, the two legs and two base plates, and if the footing is good, even the base plates can be eliminated. Reference has already been made to the new H-sections which are designed for mining purposes and their simplicity appears in the ease with which they can be used for supporting heavy loads.

STEEL TIMBERS IN THE PUMP HOUSE AT THE MID-VALLEY COLLIERY

The simplest form of construction yet devised and adapted for mining purposes, consists of a beam collar, two H-sections, lug angles at the top to prevent side motion, and absolutely plain plates for bearing. This form of construction has been successfully applied in the mines of the Mid-Valley Coal Company and is specified for 150 sets for the Lytle Coal Company, and 25 sets for the Pine Hill Coal Company; it is believed to represent the ideal form for this purpose. If the bearing plates are omitted, there are practically but three pieces to handle. One other style of prop, adopted by the Lehigh & Wilkes-Barre Coal Company, is identically the same as that just described, with the exception that instead of angles, square bars bolted to the lower flange of the collar, are used to prevent side motion. This form is to be installed at the Maxwell colliery No. 20, Ashley, Penn.

Economy in Construction

The next requirement in ideal construction is economy. This economy is based not so much on the consideration of first cost, as on matters of life and durability. Here the experience of the English mines is instructive; the average life of steel props in Warwickshire varies from 10 to 13 years as compared with three months for timber; including in this estimate the time of resetting the timber and its ultimate use for sprags and lids, and by the use of steel props and gangway supports, a saving of 2c. per ton has been effected. This saving would mean under mining conditions, a reduction of timber cost from 7.7c. to 5.7c. per ton in the anthracite region, or 26 per cent., not in itself a large item on a single ton, but amounting to $1,500,000 on the aggregate for the anthracite region alone, and, therefore, in itself a saving worthy of careful attention.

In order to illustrate the comparison of prices of steel and wood, careful calculation has been made which will indicate those features for a specific case.

Comparison of Prices of Steel and Wood

The Lehigh & Wilkes-Barre Coal Com-

pany has recently had trouble in their gangways with the 24-in. round yellow-pine timber. The gangway set consisted of the ordinary collar about 17 ft. between supports, which had legs 10 ft. 6 in. long, and required the handling in erection of 126 cu.ft. of wood weighing approximately 6,280 lb., whereas steel which is to take its place will weigh from 2500 to 1670 lb., according to the form of general arrangement followed. The wood in the present instance will be replaced by using 20-in. 65-lb. beams for collars and 8-in. H-sections for legs, the total weight of which will be approximately 1685 lb. per set. It is also to be noted that base plates will not be used. The original sets of timber were put in place about 2½ years ago and cost about $9 per set for the timber alone, or $15 erected. The steel will cost about $40 per set erected on concrete bases, and should last at least 15 years. Assume now that these values are capitalized at 6 per cent. compound interest, and that the wood timbers could be replaced at the same cost at each successive period of replacement. Then at the end of 15 years the cost of the steel set will represent an investment of $95.86 per set, while the wood will stand on the books at $153.56. The steel sets when replaced will be worth $12.03 for scrap, while the value of the wood will be nil. The saving on the steel can, therefore, be put down as $69.73 per set, and happy will the mine owner be if when 10 years from now he needs to replace his wood, he can obtain it for an advance of 50 per cent. over its present cost.

Steel Occupies Less Space

There is another advantage in this connection which should not be overlooked, and that is, that by the substitution of steel for wood, 4 in. head room is gained and 32 in. in width, that is to say, that had the steel been used for wood in the first place, the excavation could have been made 4 in. lower and 32 in. narrower, which, of course, is quite a large item where headings are driven partly or entirely through rock.

It is also an item worthy of consideration that under present conditions, the timber is absolutely worthless when it comes time for its replacement; steel, however, will stand severe punishment and yet be able to give a satisfactory account of itself in additional service, as is proved by the fact that in English mines, steel girders for roof supports have, when bent, been turned upside down without straightening in the fire and reused not less than 13 times. Under the most severe conditions, when the steel has served its purpose and has been so crippled and twisted as to be no longer safe for mining operations, it still possesses a relatively high value for sale as scrap.

Steel is the logical successor of wood in coal-mining operations, and the improvements which have been made in methods of mining, in machinery and general equipment, will not be complete until the mines themselves take their place in the chain of evolution. The ideal mine, therefore, of the future will be a mine where the wooden timbers and ties have given place to steel and where the safety and security of the operators are guarded by the most perfect and simple material yet known to the engineering profession.

Iodometric Determination of Copper

F. A. Gooch and F. H. Heath (*Am. Jour. Sci.*, July, 1907) have given the results of a study of the iodometric determination of copper. The evidence and opinions of different writers as regards the effect of various conditions in the process are extremely contradictory. The principal points of difference are the influence of an excess of potassium iodide, the volume of the solution and the effects of acid upon the formation of cuprous iodide. The authors used a solution of thiosulphate to estimate the free iodine. A series of tests were made in which 0.04 gram of copper, as copper sulphate, and 0.4 gram of potassium iodide (approximately twice the theoretical amount or an excess of 0.2 gram) were taken; the volume of solution, at precipitation, was from 30 to 80 c.c. and at the finish from 36 to 86 c.c. These tests showed plainly that the reaction was not complete under the conditions. Another series of tests at similar dilution and with the amount of potassium iodide ranging from 4 to 60 times the theoretical amount, indicated that the reaction was practically complete. That the amount of potassium iodide used has, within limits, an influence on the result was plainly shown by further tests. As a conclusion on this point, the authors find that 2 grams of potassium iodide is the uniform amount suitable for the precipitation of cuprous iodide in a volume of 50 c.c. of a neutral solution containing 0.2 gram of copper; and 5 grams as the amount if the volume is 100 c.c.

A series of blanks to determine the effect of free acid upon potassium iodide showed that a trifling amount of iodine was set free in every case, probably due to the presence of traces of iodate. Furthermore, not more than 2 c.c. of sulphuric acid or hydrochloric may safely be present with 2 grams of potassium iodide in 50 c.c. of solution, but the presence of 1 c.c. of pure nitric acid causes error. With a dilution of 100 c.c. there may be present 3 c.c. of sulphuric hydrochloric or nitric acid (free from nitrogen oxides), with 5 grams of potassium iodide, while 50 per cent. acetic acid may be present up to half the solution at either volume. The effect of these quantities of free acid, when copper was present in the solution, was the same as noted in the blank tests, with like volumes. It was clearly proved that a very considerable excess of potassium iodide, above the theoretical equivalent involved in the reaction, is necessary and that the necessary excess increases materially with the dilution of the solution.

The best general procedure in determining by the iodometric method for amounts of copper not exceeding about 0.3 gram is as follows: The solution of the cupric salt, containing no more than 3 c.c. of concentrated sulphuric, hydrochloric or nitric acids (free from nitrogen oxides), or 25 c.c. of 50 per cent. acetic acid is made up to a volume of 100 c.c., 5 grams of iodate-free potassium iodide are added, and the titration of the free iodine is made by sodium thiosulphate in the usual manner with the use of the starch indicator at the end. In case the end reaction has not appeared when 25 c.c. of the thiosulphate have been added, 2 to 3 grams more of potassium iodide are added before continuing the titration. The error of the process, properly conducted, should not exceed a few tenths of a milligram in terms of copper.

When developing a new seam in an anthracite mine, the foreman often secures a competent miner and puts him to work with the understanding that the miner is to earn "his living." The foreman watches the miner closely and keeps an account of all necessary supplies furnished him, the wages paid to his laborer, the number of cars mined per linear yard of progress, etc. After this data is collected, the foreman fixes the price per yard so that the miner is able to earn from $2.50 to $3 per shift of nine hours after all his expenses are deducted from his gross earnings. The miner is paid so much per car of coal, besides the yardage, which varies in such work from $1.50 to $5 per linear yard.

The three watchwords of mining are safety, economy and efficiency, but the greatest is safety. Of all these fundamental principles the education of the miner is of greatest importance. Nothing can be lost and much gained by teaching the miner to work, not with his hands alone, but with brain and body together.

The presence of unsuspected minerals in gold ores may be learned by the analysis of the mattes resulting from the refining of the precipitate from the cyanide solutions. According to W. P. Headden (*Proc.* Colo. Sci. Soc., Vol. VIII, pp. 349-362), there is a trace of cadmium in some of the Cripple Creek ores heretofore unsuspected and in the Camp Bird ore (Ouray, Colo.) there is more tellurium than formerly was thought to be, and also some selenium hitherto unsuspected.

The Sagamore Bituminous Coal Mines

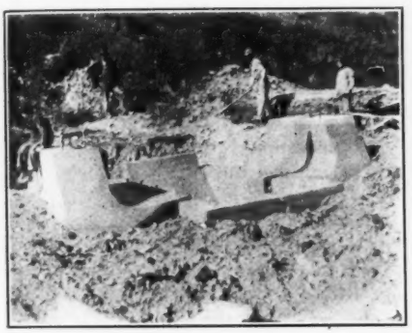
The Power Plant Cost $400,000 and Is One of the Most Complete for Coal Mining in America. One System Oils all Machinery

BY EDWARD K. JUDD*

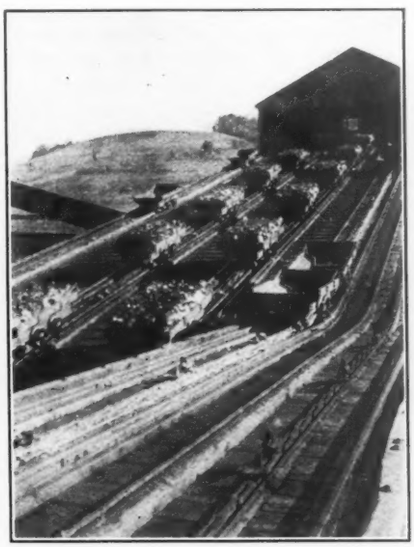
The coal mines at Sagamore, in the Clearfield district of Pennsylvania, have been opened within only two years, and in design and appliances they illustrate the latest economies in bituminous coal operations. The power plant is their most notable feature and this is probably the largest and most complete plant for coal mining purposes in the United States.

The Coal

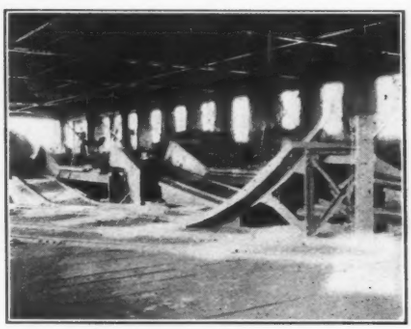
The seam is the Upper Freeport and partakes of the general features and characteristics of the coal seams in that part of Pennsylvania. The roof is the Mahoning sandstone, containing a few thin beds of slate and bony coal, which lies directly upon the seam. The floor is a hard fireclay. The bed is practically level at this point, and is not disturbed by faults of any kind.



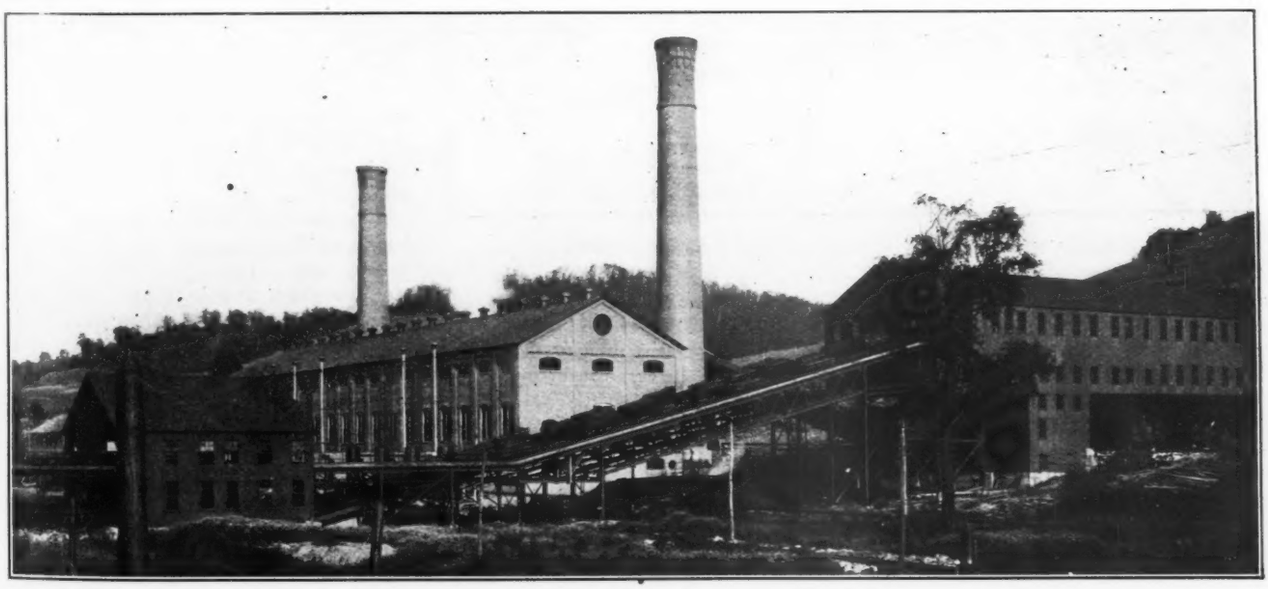
FOUNDATION FOR FAN AT SAGAMORE MINES



INCLINE TO SAGAMORE TIPPLE



INTERIOR OF TIPPLE AT SAGAMORE MINES



TIPPLE AND POWER PLANT AT SAGAMORE MINES

Location and Arrangement

Sagamore lies on both sides of the boundary line between Indiana and Armstrong counties, Pennsylvania, adjoining the town of Plumville, Indiana county, and is at present the southern end of the Buffalo & Susquehanna Railway. The coal seam is exposed on both sides of Plum creek, close to the bottom of the valley. The coal is opened at eight points by drift workings, four on the north side and four on the south side of the valley. The output from all these mines converges at one tipple. The arrangement of the mines, haulage tracks and the tipple are shown in the accompanying map.

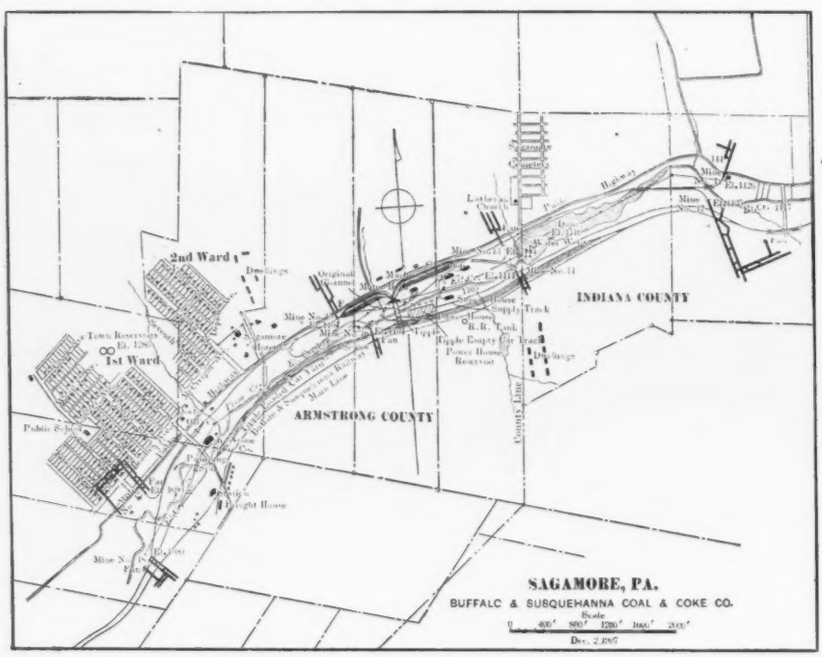
The power house is an imposing brick structure, the tipple is built of structural steel, covered with corrugated iron, and the store house, motor barn, blacksmith, machine and carpenter shops are all substantial brick buildings with slate roofs. The mining villages are somewhat separated, each occupying the summit of a hill. Water is pumped from artesian wells in

*Mining engineer, 55 Fulton street, New York City.

the valley to a reservoir on top of the highest hill.

Haulage

The coal is undercut with Sullivan punchers, shot down and loaded into 2-ton cars. These are hauled by gathering locomotives to partings in the main headings, whence they are drawn by larger electric locomotives to the foot of the tipple incline. There are six Jeffrey locomotives now at work and an equal number of General Electric Company's motors will also be in use by the end of the year. The haulage roads are laid with 40-lb. rails. At the foot of the tipple, the loaded trips from all the mines converge on two tracks, from which the cars are hauled by a chain drive up the incline to the tipple floor. After dumping, the cars kick back and are lowered down the incline by endless chain. At the foot of the incline the empty tracks are at a higher elevation than the loaded tracks, so that favorable grades are obtained in both directions.



MAP SHOWING GENERAL LOCATION OF THE PLANT AND TOWN

Shipping the Coal

The tipple spans six tracks in the railroad yard. There are three automatic dumps on the tipple floor, which, when the screens are adjusted for making lump coal and slack, permit the loading of six railroad cars at once. The coal is weighed in the mine cars, the scales being placed between the knuckle of the tipple and the dumps. In order to avoid breaking the lump coal as it comes from the screens, a pair of shaking chutes is placed at the bottom of each screen. These consist of two iron chutes, the lower end of the first lapping over the upper end of the second, but not attached to it. Each chute is supported by a hanging rod at each corner, the rods being adjustable in length so as to give any desired inclination to the chutes. The inclination is such that the coal coming upon them would come to rest were it not for a backward and forward movement of the chutes. This movement is given by two pairs of eccentrics mounted on the same shaft, which is driven by a geared motor. A stationary chute, with a right-angled turn, is placed below the lower shaking chute by which the stream of coal is deflected lengthwise of the railroad car. This permits a more regular loading of the car and also helps to start it down grade on its passage under the tipple.

The empty railroad cars are delivered at the eastern end of the yard and run under the tipple by gravity. Below the tipple the different sidings converge to a single track which goes over a railroad scale. Here each car is weighed and enough coal is thrown off or on from a platform standing beside the track to make the load weigh exactly the car's capacity, plus 10 per cent. From here on, the cars run by gravity for a distance of over 1800 ft. The locomotive then switches them onto the main line at the western end of the yard. The company anticipates dumping 1000 tons per hour over this tipple, and is now shipping over 300 tons per hour, using only two dumps, and generally not more than one.

Power Plant

With a view to greatly enlarged operations in the future, the company has erected a complete power plant, at a cost of $400,000. The output includes both electric power for motor haulage, fan driving and illumination, and compressed air for the undercutting machines.

Steam is generated at 160 lb. pressure in Rust water-tube boilers, of which ten of 350 h.p. each are now in use; there is still room for eight more boilers. The boilers have automatic feed-water regulators, and the water for the boilers is taken from the water jackets of the air ends of the compressors, passing through heaters by which the temperature is still further elevated before passing into the boilers. The boilers are fired with Murphy automatic stokers. The slack coal for these boilers comes from the tipple and is elevated to the top of the boiler room by an inclined belt conveyor. At its upper end this extends over the entire line of hopper-bottomed bins, a traveling dumper being used to distribute the stream. The coal goes from the hoppers to the stokers through circular spouts. One of the accompanying photographs shows a boiler in process of erection.

The electric plant now comprises three 500-kw., 550-volt, direct-current, Crocker-Wheeler dynamos, each of which is directly connected to a C. & G. Cooper Company's cross-compound engine, having 20- and 34-in. cylinders with 42-in. stroke and going at 100 r.p.m. The switchboard, built by the Walker Electric Company, has three generator and four feeder panels, one feeder panel for every two mines. The lighting dynamo is a 100-kw., 1100-volt, 60-cycle alternating-current generator, built by the Ridgway Dynamo and Engine Company, and directly connected to an engine of the same manufacture.

The air power plant includes four Allis-Chalmers compressors cross-compound on both air and steam ends. The steam cylinders are 26 and 44 in. diameter and the air cylinders are 26 and 42 in. diameter; the stroke is 48 in. Each compressor is rated at 1000 h.p. and compresses 5000 cu.ft. of free air per min. to a pressure of 100 lb. per sq.in. Each fly-wheel has a diameter of 16 ft. and weighs 25 tons. The total weight of each compressor is 170 tons.

A 24-ton crane travels over the entire length of the power house. All the machinery here installed is oiled by one system, in which circulates 750 gal. of oil per day. The oil from the machinery is automatically filtered and elevated to a storage tank, from whence it is supplied to all bearings.

The credit for the excellence of the entire operation at Sagamore is due to Mr. C. P. Munch, general manager of the company, who designed the plant and supervised its erection from its beginning.

Coal in Prussia is now higher than the price reached during 1900, and the railway administration has made a special freight rate on imported coals to counteract the high-priced local product.

The output of coal from the Natal collieries of South Africa for the first eight months of 1907 was 929,115 tons, against 800,100 tons for the same period of 1906.

DuBois Electric-driven Pump

Electrically-driven pumps offer many advantages, and for some work are more desirable and convenient than steam pumps, particularly where long transmissions of steam are impracticable owing to great condensation losses.

The DuBois motor-driven pump is driven by a motor through intermediate spur gearing; the complete outfit is mounted on a cast-iron base which carries the main bearings. On the end of the motor shaft is fitted a cut-brass pinion, which meshes with the large gear on the intermediate shaft. Another pinion on the intermediate shaft works with the main driving-gear on the crank-shaft. All gears are protected by heavy iron shields, which can be removed if access to the gears become necessary. The crank-shaft is a solid steel forging, and the bearings are lined with babbitt metal, and are provided with grease cups. The connecting rod to the pump is of forged steel; the crosshead is equipped with a bronze bushing, and the crank end is fitted with a bronze box and babbitted. The crosshead is of cast iron and has broad bearing surfaces; it is provided with an individual oiler.

This pump equipment can be supplied with constant or variable-speed motors of the open or inclosed type, as desired. For special mine-pumping outfits and where there is considerable dampness, the inclosed motor is used because of the better protection to the armature. The starting rheostat and switch for the motor is arranged behind the motor, as shown in Fig. 1; the outfit is self-contained and is ready for service wherever placed, after connecting the electric feed wires, and making the necessary pipe connections for the suction and discharge.

The Durability of Modern Electrical Apparatus

In the Knights Deep mine, near Johannesburg, South Africa, there were intalled thirty-six 15-kw. transformers and twelve three-phase, 50-h.p. General Electric Company's induction motors for operating the mine pumps. Through a peculiar combination of circumstances, the mine was allowed to fill with water and the motors and transformers remained under several hundred feet of water for more than two years.

When taken out, three of the motors were rewound in the local repair shop. The others were simply dried out and then soaked in oil. Contrary to all expectations and to the surprise of all concerned, the insulation was found to be in excellent condition, and the motors were put into service, apparently none the worse on account of their submersion. The transformers were treated in the same manner, and shortly afterward they replaced several English transformers which had burned out shortly after installation.

Another example of the durability of the induction motor was shown by the remarkable performance of a 5-h.p. motor which was used in driving a pump in the G. H. Perry Company's quarry in South Dakota. The motor was often allowed to run without any attention over night, especially during the rainy season. One night a heavy rainstorm filled the quarry to such a hight that the motor was half under water. When started the next morning, it picked up its load and carried it steadily until the pit was emptied of water. On examination it was found to be none the worse for its bath, although a new pulley had to be put on in place of the old one which was softened and warped out of shape.

Determining Depth of Water in Bore Holes

A new process of determining the depth of water in a bored well, while pumping is going on, is described by C. B. Burdick, in the *Journal* of the Western Society of Engineers, Dec., 1907. A known length of small pipe (¼-in. diameter) is lowered into the water. This is connected to a pressure gage, graduated to pounds. Then air is blown into the pipe and, when the needle on the gage becomes quiet, the pressure is read. This indicates the pressure necessary to sustain the column of water above the end of the submerged pipe; therefore this depth of submergence is obtained by reducing the pressure, indicated by the gage, to feet of head. The hight of water surface in the well is then easily determined.

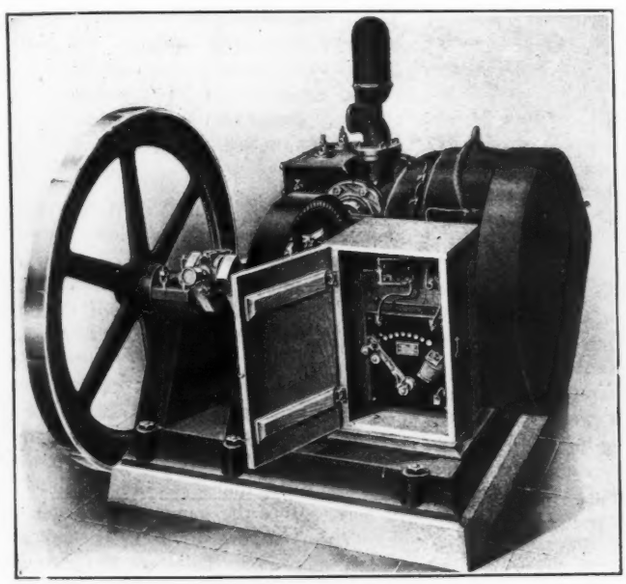


FIG. 1

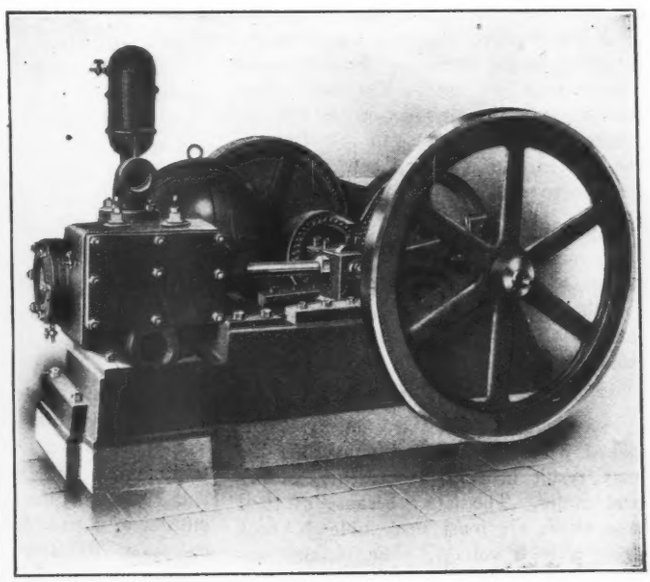


FIG. 2

DUBOIS ELECTRICALLY DRIVEN PUMP

New Steel Works

The Jones & Laughlin Steel Company is preparing to resume work on its new works at Aliquippa, on the Ohio river, below Pittsburg, which has been suspended since last November. The U. S. Steel Corporation has been pushing improvements at the Duquesne mill, where about $5,000,000 are being spent, and is hurrying the erection of the Gary plant, and this, presumably, reflects confidence in the near future of the industry. There has been a marked shrinkage in reports about price cutting but whether this is due to evidence of increasing business or to the scarcity of probable orders, depends very largely on the point of view.

The 3¼-in. machine drills at a certain large mine on the Rand average only 3½ holes, totaling 21.22 ft. in depth, per 10-hour shift.

Colliery Notes, Observations and Comments

Practical Hints Gathered from Experience and from the Study of Problems Peculiar to Bituminous and Anthracite Coal Mining

DEVELOPMENT AND MANAGEMENT

When searching a mine for black damp the examination should proceed slowly with the lamp held near the floor. When the light shows a black, smoky flame, gas is present. If in large quantities, the light will immediately die out.

According to reports of the United States Geological Survey, 66⅔ per cent. of the power represented by the installation of producer-gas plants during the last year is for using bituminous coal, while 80 per cent. of the number of plants are designed for anthracite.

A jig requires but little repairing if it is given proper attention. Neglect in this matter may lead not only to poor results, but also to the destruction of the machine. If a bolt is loose or lost it should be tightened or replaced before it has a chance to cause any serious damage.

Coal dust from the working face is of a coarse character, and not being subjected so much to atmospheric conditions as that on roadways, is comparatively harmless. Coal dust from machine-cut coal, however, is much finer and more dangerous than that from hand-cut coal.

A voltage exceeding 300 and carried in naked wires in a mine is dangerous and may result in serious accidents to men and mules. The latter because of their iron shoes are most susceptible to shock from a high voltage. The running expenses of a mine are often increased by fatal accidents of this kind.

In coal mines where the inclination of the seam is considerable, the intake should be on the dip side of the mine and the return airway on the rise side, so as to utilize the natural ventilation effect that is thus brought about by the heated return air and diluted gases which are generally lighter than the air in the intake.

The native coke burner of India, who generally has to manufacture coke in open ovens, places great faith in the use of a peculiar tool, a heavy wooden beater, called a dormise. After the oven is loaded, water is poured over the coal, and the beater freely used. This compresses the coal and causes it to adhere and coke successfully.

Statistics show that in 1848 there were 120 individual anthracite coal operators in the Schuylkill region, operating 110 mines above, and 50 below water level. In 1870 nearly 75 per cent. of all the mines in operation passed into the hands of the Reading Railroad Company. The chief cause was the partial exhaustion of the seams above water level.

In 1880 an average of 55 tons of anthracite coal was mined per keg of powder; in 1899, 39 tons per keg was the average. At the present time only 34 tons are produced per keg. The decrease in the efficiency of powder is due to two causes; (1) increase in the dead work per ton of coal mined; (2) thinner veins are mined at present than formerly.

In constructing a mine cage, the builder should use as few nuts and bolts as possible, because they are apt to work loose. Cages and winding ropes should be examined every 24 hours and a special examination should be made each week. Special attention should be given to the catches and the places where ropes and chains are attached to the cage.

If rope for hoisting is kept in stock at a colliery, it should be thoroughly oiled as soon as received, put in a dry place and covered with a waterproof covering. It should be carefully inspected from time to time and every six months should again be soaked in oil. By this treatment it will be kept in good order and ready for use at any time. When putting in a new rope, great care should be taken to prevent "kinking" which tends to break the wires and core and thus shorten the life of the rope.

Stripping anthracite coal was first introduced by Pardu & Co., in 1874, at the Hollywood Colliery. The cost of removing the dirt and rock was then 15 to 25c. per cu.yd. The operation at Hollywood continued until 1899. The stripped area covers more than 40 acres; the average depth of the debris removed is 45 ft., amounting to 2,259,110 cu.yd. removed. The percentage of the coal won by this method was 98.3 per cent. of the original contents of the seam, so that the loss in mining the bed was only 1.7 per cent.

In dry, dusty mines where the sides and roof do not permit of sprinkling, water zones, which have the effect of stopping or diminishing the force of an explosion, have been found effective in some instances. They should be arched with brick or stone and should be kept constantly wet. If the zone is situated on the main haulage road where the air current is strong, it should be of greater length than if it is placed on an entry where the velocity of the air current is low. From 150 to 300 ft. is a good length for a water zone.

The advantages of splitting an air current are many; (1) a larger volume of air is circulated at a comparatively low velocity, which factor is often ignored in ventilating a gassy mine; (2) a relatively larger volume of air is circulated by the same amount of power; (3) each panel or district of the workings is provided with an independent air current and the return of one district of the workings does not interfere with other sections, but passes away into the main return; (4) in case of a local explosion the other panels or districts are somewhat isolated and there is less chance of their being affected by the explosion.

The necessity of properly timbering a gangway or chamber is obvious when it is remembered that over 45 per cent. of the fatal accidents in the anthracite field are caused by roof falls. The roof in most seams requires great care on the part of the foreman and timberman. This is particularly so when the top is composed of a kind of fire clay and dark shale. They are quite hard when first exposed, but soon draw the moisture from the air and swell and soften and break in large chunks. In such seams the gangways are generally driven narrow, 10 to 14 ft. and the roof is allowed to fall until it forms an arch; the caved material is packed tight on one side of the road.

The annual report of the Pennsylvania State Department of Mines for 1906 states that during that year, 557 persons were killed in and about the anthracite mines of the State; 274 were killed by their own carelessness, recklessness and ignorance; 69 lost their lives through the carelessness of others; 188 through unavoidable accidents, and 26 by accidents for which the responsibility could not be placed. Of the 477 persons killed in and about the bituminous mines, 307 were killed by their own carelessness; 10 by the carelessness of others; 142 by unavoidable accidents, the responsibility of which could not be placed. In other words, 57 per cent. of the fatalities of the two regions were due to carelessness of the victims; 7 per cent. to the carelessness of others; 32 per cent. to unavoidable causes, and 4 per cent. to accidents, the responsibility for which could not be placed.

Preparation of Materials for the Blast Furnace

Kiln Treatment of Fine Iron Ore and Residues Reduces the Sulphur Content and Forms Nodules of Desirable Size for Smelting

BY DAVID BAKER*

It is well known that modern blast-furnace smelting in its present state of development in the manufacture of pig iron represents one of the most economical of metallurgical processes. This economy is found not only in the use of fuel, but also in the labor employed per ton of product. In comparing the results obtained at one thoroughly modern plant with those of another of the same kind, however, a marked difference in economy of operation is often noted; but the reason for this is not always apparent.

In investigating the matter we note that the smelting process as it is carried on in the blast furnace, is distinctly a purifying one, and that the cost of removing the impurities is a matter of much importance. It has been the practice in some localities to give no special attention to moderate amounts of impurity in the fuel, fluxes and ores, or to the physical condition of the material, assuming that what is considered a small change in the percentage of impurity makes no difference in the working of the furnace.

In justice to the practical furnace manager, be he technically educated for his work or entirely practical in his training, it must be said that he is keenly alive to the difference in the amount of fuel required in the furnace when smelting materials differing only slightly in percentage of impurity, particularly sulphur. In spite of this knowledge, it has frequently been difficult for him to persuade the proprietor or owner of the plant of the importance of reducing the work of purification required in the furnace to a minimum, in order to produce the best results. He has found it impossible to explain why an increase of 0.1 per cent. in sulphur in some fuels materially increases the cost of operation. The same is true regarding the greater difficulty of eliminating sulphur in very fine ore in the blast furnace than when the same percentage of this element is present in moderate-sized lump ore.

Sulphur and the Cost of Smelting

It needs no demonstration to show that impurities such as silica, alumina, lime and magnesia when they occur in considatable percentages and thus lower the percentage of metallic iron in the charge perceptibly, are undesirable; but how about an increase of 0.1 per cent. of an impurity such as sulphur? What does it cost per ton of pig to eliminate this in the blast furnace, and what relation does the sulphur in the charge bear to the physical condition of the same from the point of economy of smelting?

There are two methods of lightening these requirements of purification on the part of the smelting process. The first is to choose as pure materials as possible, and the second is to prepare properly the stock before using it in the blast furnace.

In the consideration of these questions, let us start with the impurities in the fuel.

For every 1 per cent. of foreign matter removed from the coal, there is nearly 1½ per cent. increase in the carbon of the coke. It will cost not more than 10c. a ton to crush and wash this coal and the ash is not infrequently reduced by this operation one-half, and in a case I have in mind, from 10 per cent. to 5 per cent., and the sulphur from 2 per cent. to 1½ per cent. in the coke. The result in the furnace was very marked; it reduced the amount of fuel required in the blast furnace per ton of pig produced 25 per cent., and made what was formerly an unprofitable blast-furnace operation a profitable one, not only by the economy of operation obtained, but by the improvement in the quality of the product.

This wonderful change in the value of the coke in this instance was due to the reduction of ash and sulphur, but the improvement described may be entirely offset if the physical condition of the fuel is not maintained at the same high standard. In other words, washed coal poorly coked may produce less satisfactory results in the blast furnaces, than unwashed coal thoroughly coked. As an illustration, let me cite another instance; I have known coal containing an average of more than 2 per cent. of sulphur, crushed fine in the Williams mill, so that it had the appearance of black meal, and would probably pass through a 40-mesh sieve, fed into the by-product ovens dry, to give a coke averaging 1.95 per cent. in sulphur, which in the subsequent smelting operation gave much better results than coke containing 1.50 per cent. sulphur made from the same coal after washing, and containing 15 per cent. of water when it was fed into the ovens.

This result was due to the fact that the ovens were kept cold by the wet, washed coal; the coke was therefore physically weak, and resembled to a large extent the product ordinarily made in gas retorts. When using dry, unwashed coal the ovens worked much hotter. I have mentioned these instances to show that if we are to reap the full benefit in the blast furnace of the removal of impurities in the fuel, we must see that the physical character of the coke is not impaired.

Briefly stated, it is just as important to have thoroughly coked, strong fuel as to have the coal washed.

Form of Impurities

The chemical condition of the impurity, particularly sulphur, is important in determining its effect on the smelting process. If for instance, sulphur is combined with iron in the form of pyrites, it is very much less troublesome. In the first place, it is easily removed by washing; fully 50 per cent. will be taken out in the subsequent coking; but if the sulphur is in organic combination, it will not be removed by washing and it practically remains unchanged until it comes in contact with the slag in the hearth of the furnace.

A comparison of the effect of the sulphur in the fuel, and that of a like percentage in the ore and limestone, shows that it unquestionably gives the least trouble in the ore, next in the limestone, and is most difficult to handle when found in the fuel. As an illustration, take the furnace practice employed when using roasted Cornwall ore and Connellsville coke. The ore and coke average 1 per cent. sulphur; 2.5 tons of ore and 2 tons of coke are required per ton of product making the weight of sulphur per ton of product 96 pounds. The practice at Sydney, N. S. W., deals with ore containing no sulphur, and with raw coal in the ovens, the coke averages 1.95 per cent. sulphur, which represents on a fuel ratio of 4000 lb. of coke, 78 lb. of sulphur per ton of product. Contrary to what might be expected, the smelting operation at Cornwall, where the sulphur per ton of product is greater, is the easier and more economical because the fuel is of good physical structure. Although a smaller total amount of sulphur was present in the other case, it was all contained in an inferior coke.

I have shown what economy has resulted by reducing the sulphur in the fuel from 2 to 1.5 per cent., and I believe that the removal of each 0.1 per cent. of sulphur until the entire amount is eliminated, will have an effect of increasing the economy of operation, but at a constantly decreasing ratio. In fact, 1.5 per cent. may be considered the limiting amount in the fuel for economical work. A large total amount of sulphur is distributed in the fuel and ore, but with no sulphur in the ore or limestone, 1.5 per cent. in the coke

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may fairly be considered to be the limit of economical working as found by practical experience.

Concentrates

Every operator of a plant or furnaces knows the importance of obtaining ore as rich as possible, and hence considerable attention has been given to different methods of ore concentration, the most important being washing by water, and wet or dry magnetic separation. In the latter method, materials are frequently treated that furnish concentrates rich in iron and of the right phosphorus content to be used to great advantage in the manufacture of pig iron, but containing such a high percentage of sulphur as to render them practically worthless for such use. Iron ores satisfactory in every other respect, except in regard to the sulphur content, have frequently been abandoned for blast-furnace use, because no process has been devised to eliminate this sulphur at a moderate cost.

There is also another disadvantage in the handling of concentrates, particularly when they are very fine (50 per cent. passing a 100-mesh sieve), from the tendency of the finely divided material to blow over into the flues and to cause top explosions and slips. There are other irregularities due to the use of fine ore in the blast-furnace charge. The material runs ahead of the descending charge and comes into the hearth in irregular quantities and in a partially reduced condition. The nature of this fine ore when present in large quantities renders it extremely difficult for the reducing gases to reach each particle of oxide; its being in compact masses isolates the ore from the gases, and when sudden movements of the stock break up the layers, the fine matter sifts down rapidly into the zone of fusion before the work of deoxidization is completed.

Nodulizing Processes

In order to overcome these difficulties a process has been developed in the last few years, which will not only eliminate the sulphur from fine ore, but will also deliver the ore in regular-shaped nodules, varying in size from that of wheat grains to that of walnuts, thus forming chemically and physically an ideal product for smelting in the blast furnace. Since the first experiments with this process, a number of different investigators have appeared in the field with slightly different methods of obtaining the same product.

For the sake of convenience we may divide these so-called different processes into two groups. Those which effect the purifying and nodulizing of fine ores, or residues by the use of a binder or flux, and those which produce the same result without any admixture of foreign matter either as binder or flux. In the first group, the material used as binders or fluxes are tar, pitch, sodium chloride, sodium sulphate, lime, ground slag, etc. All of these processes are continuous and are ordinarily carried on in long rotary kilns, somewhat similar to those used in cement manufacture.

In all of these processes the control of temperature is very important, not only in order to secure a uniformly purified product, but to prevent the material from becoming too highly heated and clogging the interior of the kiln.

The degree of purification by this method may be very high. I treated, in one case, a quantity of pyrites residue averaging 6.5 per cent. sulphur, and secured a product containing less than 0.2 per cent. sulphur.

By this method of treatment large quantities of pyrites residues in a finely divided state which have heretofore been thrown away or regarded as practically useless, may be converted into low-phosphorus iron ore of high value. At furnace plants, where there is an excess of gas, as is usually the case in the eastern part of this country, kilns may be fired with the cheap waste gases of the blast furnace using a fuel of high calorific power to secure the necessary temperature control. The cost of the method where furnace gas is not available, is from 50 to 60c. a ton; by utilizing waste gases to supply a part of the fuel requirement the cost should be reduced at least 50 per cent.

An additional advantage of this process is the possibility of treating the flue dust obtained from the blast furnace and producing from it valuable iron ore.

Effect upon Reduction

The development of this process of purification, which for convenience may be called a process for purifying and nodulizing ores, is as yet in its infancy; but enough work has been done to show that it has great possibilities. As yet, we are not able to say just where the lines should be drawn in the purifying process between the work done outside the furnace and that performed inside the blast furnace. We have so far merely worked upon materials which it was practically impossible to use in the ordinary blast furnace without preliminary treatment. There is, I believe, a much broader field for the purifying process outside the furnace. For instance, the treatment of fine ores to render the material more accessible to the furnace gases in the reducing zone of the blast furnace offers great possibilities. The very nature of fine iron ore, with its tendency to form compact masses prevents the gas from doing the work of reduction in the furnace in the upper part of the stack. It is practically a case of isolating the bulk of the fine ore from the reducing gases.

Future of the Process

It is true that the reducibility of ores depends in a large measure on the amount of surface presented to the deoxidizing gases of the blast furnace. On this basis fine ore should reduce much more rapidly than lump ore and it undoubtedly does, unless the material is so finely divided as to be impervious to the gas currents. It can be readily seen that the reducibility of ores must vary as the ratio of the size of the ore particles up to a point where the mass becomes too dense for the penetration of the gas currents, during the passage of the ore through the zone of reduction. A large part of the ore found on the Mesabi ranges is so fine as to be practically impervious to the gas currents when in a considerable body in the blast-furnace charge. If now, instead of this very fine material, the ore is prepared in lumps of just sufficient size to permit the free passage of the furnace gases, and at the same time to present the maximum surface to the action of these gases, there is good reason for believing that such material will reduce more regularly and will require less fuel than when fed raw. Upon this hypothesis is based the hopes of those interested in the purifying and nodulizing process, for a much larger development of that process in the treatment of fine Mesabi ore before it is smelted in the blast furnace.

I hope in a later article to furnish more definite information on this subject, and submit this as a brief report of progress in the experiments now being conducted with a view to securing better preparation of ores for the blast furnace.

Graphite Lubricants for Ball Bearings

After exhaustive tests with graphite as a lubricant for ball bearings, Professor Goss draws the following conclusions:

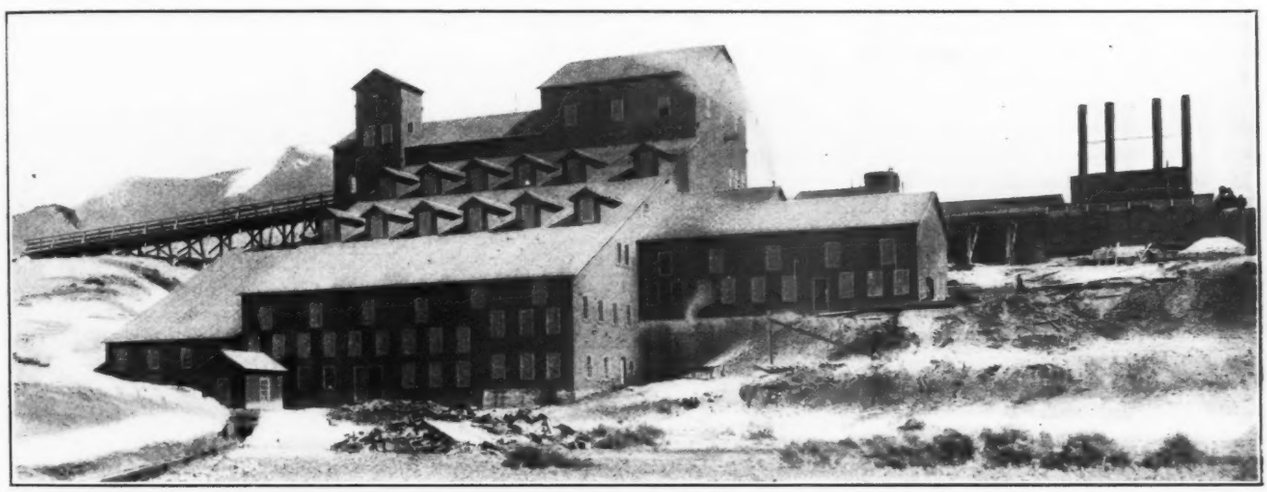
(1) A combination of graphite and lard oil when applied to ball bearings, will accomplish everything which lard oil alone will do and, at the same time, will give a lower frictional resistance of the bearing and permit a large increase in the load which it may be made to carry. (2) An oil as light as kerosene, when intermixed with graphite, will be an effective lubricant for ball bearings when operated under light or medium pressure. (3) Even so viscous a lubricant as vaseline will better perform a given service in the lubrication of ball bearings when supplemented by small amounts of graphite. The bearing to which the mixture is applied will work with less frictional resistance and will carry a heavier load than when vaseline alone is used. (4) The admixture of graphite with either a liquid or a viscous lubricant serves both to reduce the friction and to increase the possible load which a bearing thus lubricated can be made to carry.

Selenium is precipitated at the Waihi mine, New Zealand, on the zinc together with gold and silver from the cyanide solutions used to treat unroasted ore.

Mining and Milling at Stockton, Utah

By Robert B. Brinsmade*

Stockton is a small town on the west flank of the Oquirrh range, in Tooele county, Utah; it is southwest of Salt Lake City, 41 miles by the main line of the San Pedro, Los Angeles & Salt Lake railroad, while Bingham can be reached by a 15-mile trip eastward over the range, which is shown in the left background of the accompanying illustration of the Honerine mill. The town was originally established 40 years ago as a military post, called Camp Relief, by General Connor, whose headquarters were at Fort Douglas, near Salt Lake City. The mines are on the mountainside, about two miles from town. The hill slopes which are steep, but not precipitous, are covered with scanty vegetation and but few trees. There are no perennial streams in the vicinity, but enough surplus water issues from the Honerine adit to irrigate about 40 acres of alfalfa below the Honerine mill.



THE HONERINE MILL, STOCKTON, UTAH

Geology

The stratified rock, which forms the mass of the mountains, consists of carboniferous quartzite and limestone. These strata have a northerly strike and dip 50 to 55 deg. westward; evidently they form the west leg of an anticlinal fold, whose crest lies along the ridges to the east. At right angles to the strike of the sediments are a series of parallel fissures, 3 to 20 ft. wide and dipping 70 deg. to the north. The filling of these fissures is composed of blue calcite and silica, except at certain points, where ore-shoots occur. These ore-shoots are 50 to 100 ft. long and may entirely fill the width of the vein; they occur between calcite bands, which sometimes follows one or both of the walls. The shoots pitch 50 to 55 deg. westward, like the sediments, which the veins intersect; these shoots pinch or swell laterally, with frequent sprouts and tongues extending from them.

Igneous rocks are closely associated with the ores. Andesite dikes, from 10 to 60 ft. wide, are numerous in the ore zone and generally follow the bedding planes of the sediments. Dikes generally are found a short distance to the west of most of the ore-shoots; in some cases a dike forms the hanging wall. Observations were not sufficiently extended to determine the position of the laccolite, which was the source of these dikes, but large masses of similar igneous rock form the low foothills east of the Honerine mill.

The ore minerals are silver-bearing galena and pyrite together with a little sphalerite; the gangue consists of calcite and quartz. The ore was oxidized to a depth of about 200 ft. below surface. The width of the ore-shoots is well defined, as the minerals occur between the vein walls, and do not penetrate them to form disseminations.

The solutions that deposited the ore evidently obtained their heat and activity from the expiring volcanism of the igneous intrusions; it is likely that the metals in them came from the same source. The cause of the selection of the present shoots for ore deposition is not evident. As the shoots dip with the sediments, it may be that the bounding layers were purer limestone, which favored the deposition of the ore minerals from the waters passing through the vein.

As has been said, dikes have already been found to form the hanging walls of some of the ore-shoots; future development may show other such cases. This may mean that the position of the dikes was as important a factor in the location of the orebodies as it undoubtedly was in the circulation of the metal-bearing solutions. It is barely possible that the veins were first filled with calcite, and that the dikes, with their accompanying metals, entered at a later period. If this were the case, however, the intrusions would probably have faulted the veins and crushed the calcite filling, but no evidence of such penomena was seen.

There are a number of partially developed mines above Stockton, but the mill belonging to the Honerine company is the only one in the district. As the Honerine mine has been the only important producer, the methods in use at that mine will be described.

The Honerine Mine

The present Honerine holdings arise from a consolidation of old properties. Most of the ore-shoots outcropped. One of these ore-shoots was discovered in 1863 by a soldier from Fort Douglas, and was called the Connor mine after General Connor, the commanding officer. The original prospect shafts in the shoot outcrops were succeeded by an adit called the "600-ft. tunnel," as it was about that distance below the summit of the hill. Later the present Honerine shaft, whose collar is 90 ft. higher than the old adit, was sunk. A depth of 100 ft. was finally reached below the adit level by the installation of a large steam station pump in the shaft, and sinkers in an incline shaft sunk on one of the ore-shoots; but the flow of water was too great to make it practical to sink deeper.

Consequently the mine was little worked for many years. But in 1903 new capital was secured and another adit was begun from a point just west of the railroad and northwest of the shaft. The new adit cut the shaft at a distance of 2½ miles from the portal in June, 1906; since then extensions to connect with all the ore-shoots have been completed. The adit is 8x8 ft. in section; timbering was only necessary in a few places; the water runs in a flume beneath the track. The adit struck the shaft at 700 ft. from the collar

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and at this depth the ore-shoots were found as well mineralized as at the bottom of the old workings, 500 ft. higher up.

In the Honorine, there are three parallel veins, which, beginning at the north, are called the Hercules, the St. Patrick and the Honerine; the first two are about 200 ft. and the last two, 1000 ft. apart. In the Hercules vein, little ore has been found, but in the St. Patrick there is one good ore-shoot, and in the Honerine, four large and two small shoots. These shoots are 50 to 100 ft. long by 3 to 20 ft. wide and 30 to 130 ft. apart along the vein.

The Method of Mining

Overhand stoping is used to mine the ore. The walls of the orebodies are strong, and, as there is considerable waste, which is left in the stopes for support, few stulls are needed, except for covering over the levels and for carrying up the ore chutes. Where the vein is 15 to 20 ft. wide, the stulls of the first floor are angle-braced so as to support the great weight of the filling.

For driving drifts or cross-cuts 3¼-in. machines are used, but in the stopes, 2¼-in. machines, the air being supplied by an air compressor in the mill. The hoist at the Honerine shaft is kept busy handling drill steel from the blacksmith shop on the surface, and also lowering or hoisting between the upper levels and the adit. This shaft is equipped with a second-motion, double-drum, electric hoist, made by the Denver Engineering Works. There is also an electric hoist underground at the top of the old incline.

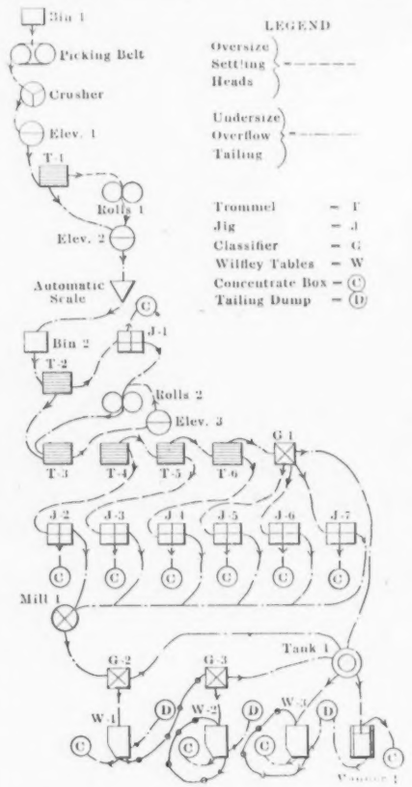
Some ore is mined from the upper workings by lessees; this is hoisted and dumped into surface bins for haulage by teams to the railroad. The ore, mined by the company, is hauled through the new adit in one-horse trains, each train being made up of 20 one-ton steel cars. A horse makes three round trips to the mill in eight hours; 8 to 12 horses are kept by the company for working in the adit and for hauling on surface.

In the mine the men work two 8-hr. shifts, one from 8 a.m. to 4:30 p.m., and the other from 6 p.m. to 2:30 a.m., including the half-hour for lunch in each case. The force comprises 50 to 60 men, of whom 15 per cent. are engaged in development. The daily output is approximately 200 tons; the ore averages 10 per cent. lead, 5 oz. silver per ton, 25 per cent. iron and 13 per cent. silica.

The Honerine Mill

The mill is situated just west of the railroad, a mile north of Stockton and near the mouth of the Honerine adit. The mill has a capacity of 100 tons in eight hours; about 200 tons were being treated per day at the time of my visit. The sulphide ore at Stockton resembles that at Park City and, as the Honerine mill was designed and built in 1904 by F. W. Sherman, the superintendent of the Daly-West mill[1], the two plants have many features in common. The accompanying flow sheet shows the arrangement of the Honerine mill.

A train of mine cars from the Honerine adit is dumped directly into bin No. 1, which, like bin No. 2, is made of wood and has a hopper bottom; the bin has rack and pinion gates, equipped with eccentric-moved pusher feeders. On the Robbins 22-in. picking belt, any smelting ore or waste is removed and the balance falls to the No. 4 Gates breaker, which runs at 400 r.p.m. Elevators Nos. 1, 2 and 3 are of the ordinary rubber-belt type with steel cups. The No. 1 rolls



FLOW SHEET OF THE HONERINE MILL

crush dry and No. 2 wet, both being belted rolls, 14x36 in. and running at 80 r.p.m. The portion of the mill designated mill No. 1 in the flow sheet consists of three 5-ft. Huntington mills revolving at 80 r.p.m., and one 7-ft. Bryan mill.

The trommels are all 36 in. in diameter by 6 ft. long and make 20 r.p.m. Water is first added to the ore at trommel No. 2. Nos. 1 and 2 trommels have woven-wire screens, the others are covered with sheet steel with round punched holes. The size of the holes in the screens on the different trommels are: No. 1, ½ in.; No. 2, 4-mesh; No. 3, ¼ in.; No. 4, 3/16 in.; No. 5, ⅛ in.; No. 6, 1/16 in. The ore is weighed on a Richardson self-registering apparatus and dumps automatically into bin No. 2, when the steel weighing hopper has received a load of 1000 lb. The mill sample is obtained by taking a hand sample from the hopper at hourly intervals.

The classifiers are of the rising-current, rectangular wooden type. No. 1 classifier has three, No. 2 has nine and No. 3 has six compartments.

The apparatus designated "tank" in the flow sheet are Sherman classifiers,[2] which vary in diameter up to 24 ft. These classify and dewater the pulp and divide it between the No. 1 Wilfley tables and the No. 1 vanners. The final overflow water is nearly clear, and runs down to the settling pond to be pumped back to the storage tanks, above the mill, into which also flows fresh water from the Honerine adit.

The Harz Jigs

The jigs are of the common Harz type with valveless plungers; their speeds are, in revolutions per minute: No. 2, 170; No. 3, 258; No. 4, 270; No. 5, 296; Nos. 6 and 7, 324. The screens are 21x32 in., made of woven wire, and all have three compartments except jig No. 1, which has only one compartment. Only the first compartment of jigs Nos. 1, 2, 3 and 4 has the side discharge, so that the first compartment of these jigs is in class A of the classification made by Prof. Richards in "Ore Dressing," Vol. I, pp. 570 to 572, and the other two compartments in class C. All compartments of jigs Nos. 5, 6 and 7 are in class C, as the side discharge is only opened to regulate the thickness of the bed. The last compartment is fitted with a sheet-steel diverter, by which the tailing, when worthless, can be flumed to the dump, instead of going to mill No. 1.

The concentrating tables are all Wilfleys. The No. 1 section has nine and No. 2 section has six tables, all running at 240 strokes per minute, while No. 3 has nine tables, making 260 strokes per minute. In the vanner section are six Frue vanners, on which 6-ft. smooth rubber belts are used, for on these the finest slimes in the mill are treated. Several centrifugal pumps are used to pump the middling and the overflow water.

Handling the Concentrate

The concentrate from the jigs assays 40 per cent. lead, and that from the tables or vanners assays from 25 to 30 per cent. lead. The concentrate falls into wooden bins having hopper bottoms, placed at the bottom of the mill, whence it is drawn off through spouts for shipment.

The mill is run by a 16x36-in. simple, non-condensing Corliss engine, which makes 90 revolutions per minute. In the engine room are also a dynamo and an air compressor for the mine.

[1]Described in this JOURNAL, July 14, 1906, pp. 53.

[2]Described in this JOURNAL, July 14, 1906, p. 53.

Calculating the Heat Balance of Lime Kilns

Data of Combustion of Coal, Wood, Oil and Producer-gas in Calculating the Efficiency of Direct and Gas-fired Lime Kilns

BY ROBERT SCHORR*

The German Engineering Society of Berlin published (Z. V. D. I. 1905 p. 1354 and 1906 p. 531) a number of investigations in connection with rotary cement kilns, which aimed to illustrate, theoretically the importance of using fuel gas in preference to coal dust or any other mode of "direct" firing.

While gas-fired kilns often give, in practice, a greater economy, not only in the consumption of fuel but also in many other respects, I fail to establish, theoretically, any material difference in the necessary heat requirement. The reasons for superior commercial results are merely of a practical nature and they will be enumerated later on.

Assume a lime rock which contains 90 per cent. of $CaCO_3$, 4 per cent. of Mg CO_3, 5 per cent. of Al_2O_3 and SiO_2 and 1 per cent. moisture. By the application of heat the two carbonates will be dissociated, resulting into the oxides and carbonic acid. The alumina and silica will form a monocalcium-silicate and the moisture will be converted into superheated steam. All reactions are simple, except the formation of the silicate. Experiments made by Le Chatlier show that the same heat is being generated but other authorities (Berthelot, in Le Ciment, 1905 p. 12) obtained different values; some of them (see Meade, Chemical Engineer, 1906) even maintain that no heat is liberated at all. In view of the very small percentage of Al_2O_3 and SiO_2 in limestones this question is not of such eminent interest and importance as it is for the theoretical investigation of the cement process. For that reason we can safely omit this item.

The $CaCO_3$ contains 56 per cent. CaO, and the $MgCO_3$ contains about 48 per cent. MgO. Consequently 100 kg. of the assumed limestone will give 56×0.90 $CaO + 48 \times 0.04$ $Mg + 5$ kg. $(Al_2O^3 + SiO_2) = 57.3$ kg. of burnt lime. The amount of rock necessary to give 1000 kg. of burnt lime is then $1000 \div 573 =$ 1745 kg. This is equivalent to 1570.5 kg. $CaCO_3 + 69.8$ kg. $MgCO_3 + 87.25$ kg. Al_2O^3. $SiO_2 + 17.45$ kg. H_2O.

Direct-fired Lime-kilns

The total number of heat units involved in the process is made up of the following items: (1) Required for the dissociation of 1570.5 kg. of $CaCO_3$; (2) required for the dissociation of 69.8 kg. $MgCO_3$; (3) required for evaporating 17.45 kg. of water and superheating the resulting steam to the temperature of the waste gases; (4) carried away in fluedust; (5) carried away in the hot, burnt lime; (6) carried away in the combustibles.

The number of heat units (1) necessary to effect the dissociation of 1 kg. $CaCO_3$ into CaO and CO_2 can be readily figured by reversing the fundamental law of thermal chemistry which says: "The sum of the formation heat of the elements, less the sum of the formation heats of those chemical combinations which resulted from the reaction, is equal to the number of heat units developed in the process." The formation heat of $CaCO_3$ from Ca, C and O_3 is 269.1 cal., of CaO 131.5; and of CO_2 94.81 cal. In making the subtraction $269.1 - (131.5 + 94.81) = 42.69$ cal. is obtained. These are required for the molecular weight of 99.76 (of $CaCO_3$), or about 0.427 cal. must be supplied for 1 gram of $CaCO_3$. To dissociate 1570.5 kg. of $CaCO_3$, $1570.5 \times 427 = 670{,}603$ cal. are required.

The calculation, in (2), is identical with (1). The heat units in $MgCO_3$ from C, O_3 and Mg amount to 266.6; MgO has 143.4 and CO_2 has 94.81 cal. Consequently $266.6 - (143.4 + 94.81) = 28.4$ cal. are required for the molecular weight of $MgCO_3$ (84). This makes 0.34 cal. per gram or 340 cal. per kg. For the dissociation of 69.8 kg. of $MgCO_3$, $69.8 \times 340 = 23{,}732$ cal. are needed.

In (3), one kg. of water heated from 20 deg. C. to 100 deg. C. and transformed into steam requires 536 cal. Assuming that the kiln gases have a temperature of 820 deg. C., it is necessary to make allowance for superheating the steam to that temperature. The specific heat of superheated steam at constant pressure being $cp = 0.48$, we have $17.45 \times 536 + 17.45 \times 0.48\ (820° - 20°) = 17.45 \times 920 =$ 16,054 cal. escaping with the superheated steam.

In (4), a kiln fired with coaldust or with liquid fuel, there will be made from 1 to 2 per cent. of fluedust. With an ordinary furnace, where wood or coal is employed, the amount of dust escaping with the waste gases will be negligible. The influence upon the calculation is a subordinate one in any event. The specific heat of fluedust is 0.21, and if the kiln loses 2 per cent. in dust the loss will be $34.9 \times 0.21 \times 800 = 5863$ cal.

In (5) if the hot, burnt lime is not used for preheating all the air necessary for the combustion of the fuel, it will leave the kiln with a temperature of 100 to 120 deg. C. Its specific heat being 0.20 and, assuming an outside temperature of 20 deg. C., we have $1000 \times 0.2 \times 100 = 20{,}000$ cal. carried in the discharged, finished product.

(6) In every type of furnace the amount of air used for combustion has a strong influence upon the volume of gas and upon the efficiency of the kiln. The theoretical air requirement can be figured from the analysis of the fuel used. In practice, however, there is always from 50 to 100 per cent. excess air if solid fuels are used, and somewhat less if the fuel is liquid or gaseous. In direct firing with solid fuels about 17 kg. of air should be a safe, actual supply for every kilogram of fuel. An average value for the specific heat of the resulting combustible is 0.265. If G kilograms of fuel are used for 1000 kg. of calcined rock, the gases issuing from the kiln will contain $18 \times G \times 265 \times 800 = 3816\ G$ cal. The following equation will follow: 670,603 cal. + 23,732 cal. + 16,054 cal. + 5863 cal. + 20,000 cal. + $3816\ G = C \times G$ wherein C represents the number of heat units in 1 kg. of the fuel employed. Letting A represent the sum of the specific heats of items 1 to 5 and B the calorific power of the gases issuing from the kiln, and by making the addition we obtain: $736{,}250 + 3816 \times G = C \times G$ or $A + B \times G = C \times G$.

Therefore $G\ (C - B) = A$ or $G = \frac{A}{C-B}$

Assuming that a high-grade bituminous coal is used, containing 7500 cal. per kg. or 13,500 B.t.u. per lb., we have $G = \frac{736{,}250}{7500 - 3816} = 200$ kg. of coal, or 20 per cent. of the weight of burnt lime produced.

Theoretical Thermal Efficiency

The total, theoretical, heat expenditure is $200 \times 7500 = 1{,}500{,}000$ cal. and $3816 \times 200 = 764{,}000$ cal. are contained in the escaping gases, which do no useful work. This illustrates the importance of reducing the temperature of the gases, by increasing the hight of the kiln and thus heating the rock charge; *i.e.*, abstracting heat from the gases. It is also important to control the flame and to avoid driving it too high into the kiln shaft. With proper care it is possible to effect a considerable reduction, and 650 deg. or

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thereabouts may be reached. At this temperature the above equation becomes: 670,603 + 23,732 + 14,630 + 4623 + 20,000 + 3005 G = $C.G$ = 713,588 + 3005 G; or G = 159 kg. of coal containing 7500 units equal to 1,192,500 cal. This is a gain of more than 20 per cent., and an additional saving would result if the air, admitted to the firebox, is preheated by providing air-ducts in the kiln structure. The theoretical thermal efficiency of the kiln in the first case is

$$T = 820° = \frac{736,250}{1,500,000}$$

= 50 per cent., and for T = 650 deg., it is about 59 per cent.

A good average performance of a modern, continuous, lime kiln, under the assumed conditions, is about 300 kg. of coal burnt for every 1000 kg. of calcined rock. In this event the actual thermal efficiency of the kiln is 32.2 per cent. if we take 725,000 cal. as the average, theoretical heat in the process. Where wood is plentiful and cheap, it is used with excellent results. The requirement varies greatly with the kind of wood and the amount of moisture it carries. The average heating value per kilogram may be taken as 3000 cal. for air-dried wood with 20 per cent. moisture. For general estimating it would be advisable to allow 2¼ to 2½ kg. of wood as equivalent to 1 kg. of coal.

Efficiency of Oil-fired Kilns

Fuel oil is used extensively in California and, as a rule, 1½ barrels (63 gal.) are required for every 2000 lb. (906 kg.) of burnt lime produced, which includes the amount of oil required to furnish steam or compressed air for atomizing. This forms from 4 to 9 per cent. of the total, depending upon the magnitude of the installation. The bulk of this oil comes from the Kern river field, and it averages 18,800 B.t.u. per lb., or 10,444 cal. per kg. Its sp.gr. varies from 12 to 16 deg. B. If we assume a specific gravity of 0.96 (corresponding to about 15 deg.), we have an oil consumption of 504 lb. per short ton, or 556 lb. (253 kg.) per metric ton. This is equal to 2,642,332 cal. The actual thermal efficiency is then 26.4 per cent.

In view of the exorbitant coal prices in California and the low cost of oil per 1000 heat units in most locations when compared with any other fuel, the commercial results are greatly in favor of using oil. The low efficiency, however, indicates that there is a wide opening for improvements. While the oil possesses only 1.39 times more heat units per kilogram than the coal of 7500 cal., experience with modern boiler and industrial furnaces shows that it will do 1.5 to 1.65 times the amount of work, due to a more perfect combustion and to a more thorough regulation of the air supply. Taking these performances into consideration, we should expect to reach, with 45 gal. of oil per short ton of burnt lime, a kiln efficiency of 38 per cent. The present application with standard oil-burners is very imperfect. The flame impinges upon the stone charge only in two, three or four places; this centralizes the heat locally and gives a rather poor product compared with lime burnt by well diffused flames. I believe that very much better results would be obtained by burning the oil in trays, similar to those used in crucible-steel furnaces, by arranging a combustion chamber all around the kiln shaft, and by providing adjustable air inlets. From this combustion chamber a large number of small ducts should connect with the inside of the kiln-shaft to assure a thorough flame distribution.

It would not pay to make an oil-water gas, as the efficiency of these generator sets is rather low even if the lampblack and the tar, obtained as waste products, are re-used in the generator. While the fuel consumption may not be greater than with oil burners and, while the repairs on the kiln-shaft would be considerably less, the cost of maintenance of the generator, the greater first cost of the whole installation and the greater cost of labor will offset all advantages otherwise gained.

Producer-gas-fired Lime Kilns

The heat items, Nos. 1 to 5, naturally remain the same. To establish the sixth item we must know the weight of the combustibles, and this in turn is governed by the volume of air used. The theoretical amount can be figured from the gas analysis, and the actual air supply in practice is about 25 per cent. larger. A producer-gas of 1120 cal. per kg. will require, in practice, about 1.16 cu.m. of air for 1 cu.m. of gas burnt, resulting in about 2.5 kg. of combustibles. If G_1 kg. of gas have to be supplied for every 1000 kg. of finished lime, there are 2.5 × G_1 × 0.265 × 800 = 530 × G_1 cal. in the escaping gases at 820 deg. C. temperature. The heat equation reads then: 736,250 + 530 G_1 = 1120 G_1. Therefore G_1 = 1281 kg. of gas. This corresponds to

$$\frac{1281 \times 1130}{7500} \text{ cal.} = \frac{1,434,720}{7500}$$

= 191 kg. of coal.

As 1 cu.m. of gas requires, in the generator, 0.1 kg. of superheated steam, we have to add about 20 kg., thus making a total of 211 kg. of coal per 1000 kg. of burnt lime, or 21.1 per cent. Under favorable conditions we may expect 80 per cent. generator efficiency, and, if the generator is built into the kiln structure, the losses, due to radiation and contact, will be very small, probably not more than 6 per cent. This results in a combined efficiency of 74 per cent. for the generator installation, and in this case, $\frac{211}{0.74}$ = 285 kg. of coal will be consumed. If the gas-ducts are long, the radiation losses may rise to over 15 per cent., in which event more fuel would be consumed than in direct firing.

Advantages of Gas-fired Kilns.

In very high kilns a considerable amount of heat is extracted from the escaping gases by the cold-stone charge, and temperatures considerably below 820 deg. C. are quite frequent. The influence upon the fuel economy here will be as marked as in direct-fired lime kilns. The calculation has conclusively shown that an economy in fuel can be obtained by the use of producer gas only if the installation is executed in the best possible manner and if the losses, caused by radiation and by contact, are reduced to a minimum. Furthermore, the gas-fired lime kiln assures the following advantages:

(1) The diffused heat excludes clinkering and irregularities of operation resulting in a finished product of superior quality. The flame is under thorough control, and can be maintained at a uniform temperature, thus assuring a perfect and pure lime. (2) The life of the kiln shaft is prolonged considerably. (3) The burnt stone is utilized to preheat the air used for combustion, and the lime is discharged almost cold. (4) The lowest grades of fuel can be gasified to great advantage. (5) The gas-fired kiln requires little labor.

In some German gas-fired kilns the shaft is surrounded by an air-jacket, and cold air is drawn through the space by means of a stack which connects with an iron box into which the fuel for the generator is fed. The same stack connects, farther up, with the kiln shaft when the recovery of carbonic oxide is not practiced. In this way the hottest portion of the kiln shaft is cooled, and the warm air is utilized to preheat the fuel, which leads to an additional gain in economy. Producer gas has long been more generally applied in Europe, but during the last few years great progress has been made in this country. The gas generator is used to-day quite extensively in brick, lime, pottery and cement kilns; in roasting and smelting furnaces; and for power purposes. With the gradual advance in the price of coal the gasification of lower grades of fuels (brown coal, lignite and peat) and of waste products (wood refuse, coal-washery sludge, etc.) will undoubtedly be taken up on an extensive scale. In processes, where the waste gases escape at a high temperature, regeneration should be employed when practicable.

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Illustrated.

New Things in Metallurgy

Metallurgists are always devising new things in their art, but an uncommonly large number of promising novelties appear to be coming to a head at the present time. We shall enumerate some of them without entering into any extended comment upon them.

The experiments with dust-firing at Cananea have been referred to in previous articles in the JOURNAL, particularly by Mr. Shelby, in the issue of March 14. This is a promising development that bids fair to be of much usefulness.

At Rio Tinto, Spain, where pyrite smelting is now being done (in six furnaces), Parsons turbine blowers are used. Operated in tandem, they deliver air against 60 oz. pressure, and are said to be of high efficiency, economical, and satisfactory in all respects save that there is an extraordinary and enormous noise at the intake of the air, which is next to unbearable to persons having to work anywhere near-by.

The sulphur-smoke problem is the subject of two interesting developments. At the Selby works, near San Francisco, experiments (reported to have been highly successful) have been made upon the oxidation of sulphur dioxide to trioxide and the precipitation of the latter as sulphuric acid by static electricity. It is believed that something important will come of this. At the United States works, near Salt Lake, the process of neutralizing the sulphur trioxide in the smoke by zinc oxide has been introduced successfully. This permits the smoke of roasting and matte-smelting furnaces to be filtered through woolen bags. It has been tried sufficiently long to prove that the danger to the bags can be eliminated in this way.

For the sintering of fine ore the Dwight & Lloyd machine, which has had a long and careful trial, first at Cananea, then at Perth Amboy, and later at Baltimore, has proved successful, and promises to be an economical means for the desulphurization and sintering of fine ore, which will have an important effect not only upon the metallurgy of copper, but also of lead.

Renewed attention is being directed toward the lixiviation of oxidized copper ore with sulphuric acid and electrolytic precipitation of the copper, of course, with insoluble anodes. Experiments that have recently been conducted promise successful results in the case of a certain important ore, and it is likely that this process will be developed to usefulness in places where fuel is dear, water power is cheap, and the ore is deficient in iron pyrites, conditions which exist in several important occurrences of copper ore.

Incidentally it may be remarked that in roasting a batch of several tons of ore containing about 18 per cent. copper and 16 per cent. sulphur, a new multiple hearth furnace (the Wedge) was able to bring the ore down to 1.3 per cent. sulphur (largely in the form of sulphates) without the use of any extraneous fuel, notwithstanding the low sulphur content of the original ore.

At Isabella, Tenn., sulphuric acid is being made successfully from the waste gases from the pyritic smelting furnaces. At Mansfeld, Germany, we understand that the gases from the converters are being similarly employed.

These are a few examples of the improvements in metallurgical practice that are constantly going on.

A New Mining and Metallurgical Society

A plan is on foot to create a new American mining and metallurgical association, which shall be restricted in its membership to those with technical qualifications, and shall be in a position to take a positive stand in matters affecting the ethics of the profession and the welfare of the public, aiming also to promote and maintain the dignity of professional work in the arts and sciences connected with mining and metallurgy.

We understand that nearly 100 well known engineers and geologists have already been enrolled as charter members. However, no formal organization has yet been effected. That this movement has in a short time gained the support of so large a number of well known professional men indicates that there is a feeling that an organization like the proposed one is needed in this country.

If the present project proceds so far as formal organization, it is to be hoped that the new association will adopt measures designed to insure cordial coöperation between it and the American Institute of Mining Engineers. The latter is prevented by its constitution from formally representing professional opinions in any way, and has found its sphere of usefulness largely in the publication of its transac-

tions, which embody a large part of our most valuable technical literature. In the performance of this work it has reflected honor and credit upon its organizers and upon those who have been prominent in the management of its affairs, and there is no necessity for duplicating its work, or encroaching upon its field of usefulness.

This is fully recognized by many who are promoting the new association, most of whom are members of the Institute of long standing, inasmuch as they are aiming to plan the new organization so that it shall not be, or hereafter become, a rival of the Institute. No one ought to desire to see anything done which might adversely affect the usefulness and welfare of the American Institute of Mining Engineers, and it is the intention of many of the promoters of the new society not to enter into rivalry with the Institute, or be otherwise than loyal to it. This spirit is manifested clearly by a proposition that membership in the Institute be a prerequisite to membership in the new society. All mining and metallurgical engineers ought to be members of the Institute anyway. Moreover, it is undesirable that the new society should invade the special field of the Institute by publishing technical papers in its proceedings, but rather it should confine the latter to discussions of matters brought before it for consideration, and essays and papers contributed by its members in furtherance of its particular objects.

If these intentions be carried out, no friend of the Institute will have cause to deplore the rising of a new society on the ground that it would detract from the Institute. On the contrary, it is possible that the new society might strengthen the Institute. Whether the interests of the profession will best be served by an independent organization working with the Institute as an affiliated society, or by the Institute expanding its field of activity to cover the objects of the new association, are questions which perhaps can be answered only by trying one or the other of these plans.

The Western Coal Mining Situation

The settlement of the coal-mining rate for next year in the West, which is likely to have an important influence on business, is still uncertain. Four preliminary conferences already held have failed to reach any agreement on the point whether the district agreements now in force shall be continued, or whether a return shall be made to the old Interstate agreement. That agreement covered what is known as the Central Competitive Field, including the bituminous mines of western Pennsylvania, Ohio, Indiana and Illinois; and indirectly it regulated the mines of Iowa and of the Southwest, which always followed the terms of the Central field.

The renewal of the Interstate agreement now seems to rest entirely with the operators. At former sessions the United Mine Workers have declared themselves in favor of the general agreement, and the convention now in session at Indianapolis holds to this opinion. But despatches sent out to the various State associations of operators have failed to draw out any satisfactory answers, owing to divided opinions on the side of the employers; and it is quite possible—even probable—that the miners may adjourn without result. The consequence will be a general strike, or at least a suspension of work, on April 1, which will last until the question is settled. The effect of this will certainly be to retard the revival of trade and to unsettle conditions still farther than at present.

The differences of opinion seem to be local and, in part at least, based on short-sighted views of possible advantage. The Ohio and western Pennsylvania operators, it is said, are not anxious for an early settlement, largely because many of them have stocks of coal stored at various points near the mines, at the lower lake ports and at the head of the lakes which they are carrying at considerable cost. In case of a suspension these stocks may command strike prices, especially on the lakes. This prospect of an immediate profit seems to outweigh all other considerations. The Indiana and Illinois operators are not so favorably placed; they fear the loss of competitive trade, which they will not be able to supply in case of a stoppage, and they also fear that the West Virginia mines will step in and secure a still larger share of the trade than they captured some years ago, under similar circumstances. On the whole, the Indiana-Illinois view seems to be the correct one, when all the conditions are taken into account.

The difference between miners and operators is more on the form of the agreement than on the wage question. If a general meeting is held, the miners will probably ask for a small advance in the mining rate; but this will be only a bluff, and their utterances thus far made indicate that they will be well satisfied with a continuance of the present rate. They will probably be willing to accept some reduction, if coupled with assurances of a return to the present schedule, should trade improve. This, they believe, can only be secured through the general agreement.

It seems almost certain now that there will be a suspension of mining on April 1. The question is whether this will be a suspension until matters can be amicably adjusted, or a strike with all its accompanying ill feeling and uncertainties. The miners have shown no desire for the strike. In fact through the whole discussion they have had rather the advantage, because they were united and knew what they wanted; while the operators were divided and uncertain.

THE VALUE OF the geological work of the U. S. Geological Survey in western mining districts is apparently becoming more and more appreciated by miners and operators, as evidenced by the large and constantly increasing demand for Survey reports. It is therefore to be regretted that insufficient funds for the publication of reports of the Survey is resulting, according to statements made, in the delay in the issuance of a number of completed reports of important economic geological areas. Timeliness in the publication of these reports comes next in importance to accuracy and sound judgment.

AMONG THE MYTHS that strangely continue to exist is the one that the large exports of copper to China in 1905 were for speculative purposes, the copper being bought on the rising market and shipped back to Europe and America at the top of the boom. A comparatively small quantity was indeed returned, but the bulk of the Chinese purchases were consumed for coinage, the statistics of the mintage accounting for the bulk of the copper that went to China. Of course, these statistics are available to anyone who will take the trouble to look for them.

Views, Suggestions and Experiences of Readers

Comments on Questions Arising in Technical Practice or Suggested by Articles in the Journal, and Inquiries for Information

CORRESPONDENCE AND DISCUSSION

The American Chemical Society

The editorial on "The American Chemical Society" in the JOURNAL of Feb. 8 has just been brought to my attention.

In discussing the report of a certain committee of our New York section (on the qualifications of chemists) and the attitude of the society toward the proposal to establish an institute of chemical engineers, the JOURNAL subjects the American Chemical Society and its presiding officer to criticism which is unkind in tone and unmerited in fact.

It will be a courtesy to the society and to its president if I may be permitted to point out wherein the criticism is unkind and does not correctly represent our attitude on certain important matters. I am confident that you will grant me this privilege, for I am sure that it is not the intention of the JOURNAL to criticize any individual or organization with undeserved severity, least of all an honored association of scientists like the American Chemical Society, many of whose members are also, and very properly, your hearty supporters; and yet, in reading the editorial, it would appear that the society had demonstrated its inability to handle the problem of raising the standards of the chemical profession, that its committee had proved incompetent, and that in the case of the chemical engineers' proposed organization the society was pursuing a dog-in-the-manger obstructionist policy. That is not a light arraignment, and can hardly be passed by in silence.

WORK OF COMMITTEE ON QUALIFICATIONS

As to the report of the committee on the qualifications of chemists, their chief work consisted in gathering together the arguments for and against the various methods suggested to secure the desired end. In such a summary, it is not strange that certain of the arguments advanced on one side or the other should appear "lame" to those of different opinion. The fact should be kept in mind that this committee was only a committee of one of our local sections. The members did all that was possible under the circumstances —collected the necessary data, expressed an opinion upon the same, and transmitted their report to the general council of the society. This was the proper procedure, as the subject was one which concerned chemists in all parts of the country and not only those enrolled in the New York section. The statement that their conclusion was "practically to do nothing" is, therefore, scarcely fair to the committee. The report was received by the council, at its Toronto meeting last summer, and the president was authorized to appoint a committee of the society to take up the whole subject. Far from doing nothing, this committee is hard at work, under the able chairmanship of Dr. Clifford Richardson, one of the board of visitors of the chemical department of Harvard University, and the author of the recent paper on "A Plea for the Broader Education of the Chemical Engineer" (*Science*, N. S., 27, 81-9), considering the two main sub-divisions of the problem—(1) the training of chemists in our technological schools, colleges and universities, and (2) the maintenance of high standards among those practicing the profession. These are matters of vital importance to all chemists, and will be very carefully studied before any definite line of action is recommended.

PROPOSED INSTITUTE OF CHEMICAL ENGINEERS

With reference to the proposed establishment of an institute of chemical engineers, it is decidedly unjust to the American Chemical Society to state that it "could hardly be expected to recommend . . . the creation of a new chemical society." On the contrary, the American Chemical Society should be and would be the first to recommend the establishment of another separate chemical organization were such clearly desirable. It is not at all unlikely that the founding of an institute of chemistry will prove to be the best way of raising the standards of the profession, and in the event of such a decision the American Chemical Society will not only recommend the founding of such an institute, but will also lend its powerful support in carrying the movement to a successful conclusion.

In justice to the society it should be clearly understood by all that it exists for the profession and solely by virtue of its loyal and enthusiastic support. It is not run by or in the interests of any one clique or group, but is the servant and helper of all in developing the science of chemistry in our own native land. Its power for good, as I have had occasion to say before, is measured only by the character and extent of the support accorded it by those whose it is and whom it serves —the chemists of America. It has a large membership (between 3500 and 4000) and an efficient organization, and it would be a serious error for any group of chemists to establish a separate chemical society without first ascertaining whether what they wish to accomplish cannot be still more effectively carried out by their own American Chemical Society.

With the organization of the industrial and engineering chemists within the American Chemical Society, the publication of *a Journal of Industrial and Engineering Chemistry*, and a movement actively on foot for raising the standards of the profession, it did not seem to the writer an "unfriendly" or "improper attitude" to point out these facts to our chemical engineering colleagues, and to express the conviction that it would be a mistake to found a separate society at the present time. As the one largely responsible for the above movements, and as a former vice-president of the Society of Chemical Industry, it can scarcely be held that I am personally indifferent or inimical to the interests of the industrial and engineering chemists.

MARSTON TAYLOR BOGERT,
President American Chemical Society.

Columbia University, New York, March 12, 1908.

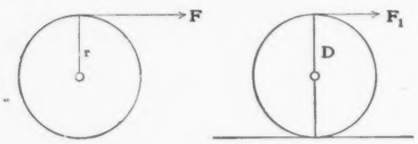
Mechanical Efficiency of Tube Mills

I agree with what Mr. White says in the JOURNAL of Jan. 18. If I remember rightly it has been claimed by Mr. Abbé that the support on rollers causes a great saving in power. Now, take a tube mill revolving on gudgeons and it will be found that it requires a certain pull on the circumference to make it revolve, applied at a distance equal to the radius of the tube mill from its point of support. Place this tube mill on rails and apply a pull on the top; this pull will be half of the previous pull, but will be twice as far from the point of support, therefore the work done will be the same in both cases.

To prove this let us assume first that the mill be mounted on gudgeons, and therefore revolves around its axis. The force F required at the circumference, to maintain equilibrium, taking Mr. White's formula, is $Wd \div r$, where $W =$ weight of charge, $d =$ horizontal distance of its center of gravity from the center of the mill, and $r =$ radius of the mill. If s is the peripheral speed, then the work done is $Wds \div r = F$.

Now assume the mill to roll on a horizontal track, as suggested by Mr. Abbé. A man, in pushing the mill along the track, will naturally exert his force as near the top as possible, so let us assume the force

as being applied in a horizontal direction at the top of the mill. The weight of the charge and its center of gravity remain the same. The force F, applied at the top will have as lever arm the diameter of the mill, $D = 2r$. As the mill rolls along the track its center moves in a horizontal line, so that the same amount of power as before is required to lift the pebbles to maintain equilibrium. However, the mill in this case can be assumed to revolve around a momentary center where it comes in contact with the track. The force required at the top will then be $F_1 = Wd$



APPLICATION OF FORCE IN DRIVING TUBE MILL

$\div D = Wd \div 2r$. For the same peripheral speed the work done is the same in both cases, therefore if $Wds \div r = F$, then $Wds \div 2r = F_1$ and $Wds \div r = 2F_1$, or $F = 2F_1$.

It can be seen from the above that if it be attempted to revolve a tube mill resting on gudgeons twice the *force* is required, if applied at the top, than if the mill rests on rails. The lever arm in the former case is, however, half of that in the latter, so the moments (force $\times$ lever arm) are the same and therefore the work done is the same.

FRANK A. LOCKWOOD.

Denver, Colo., Feb. 23, 1908.

The Monongah Explosion

I note the remarks of W. Clifford in the JOURNAL of Feb. 22 *re* my explanation of the possible electrical action as the cause of the Monongah explosion. I should like to say that I wrote my former letter immediately on the arrival of the JOURNAL, with the first news of the explosion, and with the first reports, in which it will be remembered, it was suggested that the trolley wire had caused the explosion. I should like to say that subsequent evidence appears to me to show that the trolley wire had nothing to do with it.

I approached the matter, of course, from the electrical point of view, but apart from the opinion of the able mining engineers who have examined the question, that the ignition took place in No. 8 mine, the strongest evidence, from the electrical point of view, is the fact which I understand came out at the inquest, that there was no sign on the trolley wire, or the rails, of any sparking having taken place. Except where the whole of the evidence is destroyed by the force of the explosion, or fire, where one occurs, I do not remember any case in which a spark has passed between two conductors, and particularly when an arc has been formed between them, in which characteristic evidence was not left, in the form into which the ends of the conductors were fused. I should have expected to find the trolley wire burned in two, the end connected to the supply service being fused up in the characteristic button, and also marks of fusing to be apparent on at least one of the rails. I gather also from the evidence at the inquest that the circuit breaker in the generating station tripped instantly, so that there was no time for an arc to form.

SYDNEY F. WALKER.

Bloomfield Crescent, Bath, Eng., March 4, 1908.

How Should This Mine Be Operated?

A copper property, developed as described below, has been the subject of some discussion as to the most economical method to be adopted for ore extraction, at the same time yielding the maximum amount of ore in a given time. I shall be grateful for suggestions from readers of the JOURNAL.

The vein pitches at an angle of about 70 deg. A shaft has been sunk on the vein at this angle, and levels have been driven some distance in both directions at 150 ft., 250 ft. and 350 ft., but no other connections have been made between levels. A skip is used for hoisting. The vein is from 12 to 20 in. wide. The levels must be maintained permanently; the physical condition of the ground demands practically no timbering. It is required to leave no more ore in the mine than necessary to support the floor and roof of each level. No stoping is to be done within 60 ft. of the surface. Hand or air drills may be used.

R. E.

El Paso, Texas, Feb. 28, 1908.

Rosita Colliery Explosion

In the JOURNAL of March 7, under "Coahuila" in the news columns there appears an item relative to the explosion in one of our mines on Feb. 27. This item contains a number of errors, which the JOURNAL will no doubt be pleased to correct. The following are the exact facts:

The explosion occurred at 5 a.m., Feb. 27, and was probably caused by the burning of coal dust together with an insignificant amount of gas; the mine was well ventilated, having more than 8 cu.m. of air for each person working in it. Although the casing of the fan was destroyed and one of the cages, and the sheave wheel was thrown off the shaft and torn to pieces, and the tipple was badly damaged, rescue work was immediately begun and about an hour after the explosion the relief party succeeded in taking out the only man that was found alive.

In the evening of that same day the ventilation was restored and the work of taking out the dead bodies of the miners was begun, without the intervention of the Federal Government. The company's representatives know what their duty is in such cases, and they have done everything that could be done in any civilized country to relieve the situation. The number of men in the mine at the time of the catastrophe was 76, of which eight were Japanese, one Spaniard, one American and the remainder Mexicans.

These mines are not owned by the Monterrey Steel Company, but are the property of the Compania Carbonifera de Sabinas, and 1500 men are employed, not 250 as stated in the despatch published in the JOURNAL.

MANUEL SCHWARZ.

Rosita, Coahuila, Mexico, Mar. 12, 1908.

The Venezuela Asphalt Case

According to press despatches from Caracas, Venezuela, March 12, the Superior Court of Venezuela on that date handed down a verdict confirming the judgment of the lower court which condemned the New York & Bermudez Asphalt Company to pay a fine of $5,000,000 to the Venezuelan government for having extended assistance to the Matos revolution, which was directed against President Castro. This sum is the estimated cost of putting down the revolution. The company will appeal to the Court of Cassation.

The finding of the lower court referred to in the above despatch, which is the Civil Court of First Instance, was handed down in August, 1907. The appeal to the Court of Cassation is now the only thing that remains to the company, so far as the situation in Venezuela is concerned. It was from American witnesses and from testimony taken before American judges in United States courts that the Venezuelan government obtained its most important proof of the part alleged to have been played by the asphalt company in the Matos attempt at revolution. The charge that the company aided the revolution with funds has been substantiated, officials of the company having testified to the truth of this statement in New York in 1905.

The controversy between the company and the Venezuelan government has been long and bitter, and was in a critical state at the time that Herbert W. Bowen was American minister at Caracas. On that occasion the State Department sent what was practically an ultimatum to Venezuela.

While in conduits the resistance to flow of water varies as the square of the velocity, the resistance to flow through porous material, such as silt, sand and gravel, varies as the velocity.

Osceola Consolidated Mining Company

The report of the Osceola Consolidated Mining Company for the year 1907 gives the following comparative results for 1906 and 1907:

STATEMENT OF OPERATIONS, OSCEOLA CONSOLIDATED MINING COMPANY.

	1906.	1907.
Tons rock stamped	1,016,240	811,603
Mineral obtained (lb.)	24,227,281	18,607,747
Percentage refined copper in mineral	76.725	75.962
Refined copper per ton of rock stamped (lb.)	18.3	17.4
Product fine copper (lb.)	18,588,451	14,134,753
Cost per lb. at mine, excluding construction	8.73c	10.59c
Cost per lb., construction	0.84c	0.60c
Cost per lb., for smelting, freights, eastern expenses, commissions, and all other charges	1.32c	1.25c
Total cost per lb. of refined copper	10.89c	12.44c
Cost of mining and stamping per ton of rock stamped	$1.60	$ 1.84
Gross cost of stamping per ton	16.39c	17.47c
Net cost of stamping per ton after deducting profit on custom rock	13.83c	11.71c

From the above, it appears that the total costs per ton for 1907 were $2.16 against $1.99 in 1906. This increase of cost was an experience this company shared with nearly all other mining companies in 1907.

The report states that the old Osceola mine shows large reserves of copper toward the south end, the northerly shafts being more nearly worked out. At the North Kearsarge mine No. 1 shaft was damaged by fire in September, 1906, and was repaired at a cost of $36,950. This was charged to operating expenses. The report contains little additional information of interest. The total dividends to date are $7,035,650.

Assay of Telluride Ores

G. T. Holloway and L. E. B. Pearse (*Trans.*, I. M. M., *Bull.* 39) have made an exhaustive study of the causes of the gold losses in assaying telluride ores. Several methods for the qualitative determination of tellurium are described. Early experiments proved that the direct loss of gold by volatilization during roasting was slight, and was not affected by the presence of mercury. The loss of gold by volatilization during the cupellation of lead buttons, obtained from any ordinary telluride assay, was found to be extremely small, in fact not greater than in the tellurium-free lead buttons. The cupellation loss evidently depends on the ratio of lead to tellurium in the lead button; for instance, an alloy containing 60 per cent. lead, 20 per cent. gold, and 20 per cent. tellurium gave an absorption loss of 7.5 per cent. gold in cupelling. The cupellation of this same alloy with a sufficient excess of lead gave a normal volatilization and absorption loss.

There is practically not any loss of gold in the slag in scorifying highly tellurous lead, but there is a condition in scorification which greatly affects the loss in the subsequent cupellation. If a 50-gram lead button was scorified down to two-thirds its weight, it was found that a considerable portion of the tellurium was expelled; but if the scorification was carried farther, and especially if the lead was allowed to remain under the slag for any length of time, the tellurium was reduced from the slag, re-entered the lead and enriched it to a greater extent than before scorification. The enriched button from such a scorification would undergo a heavy loss in cupellation. The authors' summary is: (1) If the lead button from the crucible assay be kept large the tellurium will be mostly eliminated in the earlier stages of cupellation and the gold loss will not be appreciably affected.

(2) A preliminary scorification of the large lead button to two-thirds of its original weight is advantageous.

(3) If the proportion of tellurium to gold be small in comparison with the lead in the alloy to be cupelled, the loss will be normal.

The scorification method for the original treatment of the ore is not satisfactory on account of the smallness of the charge, the danger of mechanical loss and poor decomposition of the ore. The authors recommend the crucible-fusion method, after trials of many different methods, as best suited for the assaying of telluride ores, both for gold and silver. Among the various charges recommended for different grades and kinds of telluride ores is the following for average-grade highly silicious ores: Ore, 50 grams; red lead, 120 grams; soda ash, 60 grams; borax glass, 10 grams; flour, 7 grams.

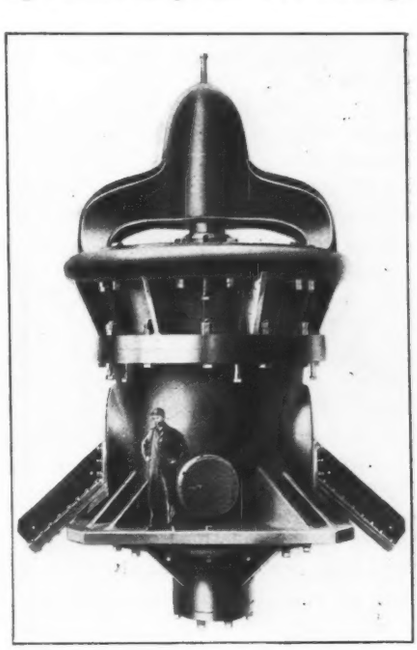
In general, it was found best to use a charge which yielded a basic slag, fusible at a low red heat, as an acid slag gave low results. The addition of fluorspar to the charge was beneficial. The lead button should be large and should be scorified as a preliminary to cupellation as mentioned before. Salt sould not be used for a cover. Fine grinding is essential in the sampling and assaying of telluride ores. The authors recommend that none of the wet methods be employed except possibly in the cases of certain rich copper or other uncommon ores. The conditions for the wet assay, if used, are described, as well as methods for working up slags and cupels.

At Rand mines in October, 1907, there were 62 tube-mills in operation.

An Immense Gates Breaker

One of these crushers, the largest size made, has just been finished by the Allis-Chalmers Company, of Milwaukee, Wis. It is built for the Casparis Stone Company, of Columbus, Ohio, and will be used for crushing the rock brought direct from the quarry. The accompanying engraving gives a good idea of the hugeness of this rock-breaker.

This breaker is 25 ft. high and has a width of 14 ft. across the top shell; it weighs approximately 400,000 lb. The minimum feed opening between the crushing surfaces is 36 in. Two discharge openings are provided instead of one, as is usual with smaller breakers.



GATES BREAKER

So large a breaker can only be used in large quarries where the broken rock is loaded onto cars by means of large steam shovels. With this breaker no preliminary block-holing or sledging is required. The crusher will be installed so that the quarry cars, hoisted up an incline, will dump automatically into the top of the breaker.

The capacity of this huge breaker has not yet been determined, for it is found to be almost impossible to bring stone from the quarry fast enough to choke the breaker.

The revolving cylindrical driers, introduced in Tennessee within the last two years for drying phosphate rock, vary, according to Granbery Jackson (*Proc.*, Engineering Association of the South, Vol. XVIII, No. 4) from 6 ft. diameter by 40 ft. long to 4 ft. diameter by 24 ft. long; the favorite size is 5x32 ft., the capacity of which is about 6 tons of dry rock per hour.

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

Walter Harvey Weed, of New York, is in Mexico on professional business.

James Ross, president of the Dominion Coal Company, is at Atlantic City, N. J.

Sir Claudius Stanhope, of London, is in Mexico looking after certain mining interests.

A. G. Cushman, of Rhyolite, Nev., is examining properties at Acapulco, Guerrero, Mexico.

E. P. Earle, president of the Nipissing Mines Company, was in Ottawa, Canada, recently.

J. Morgan Clements, of New York, has been looking over some lead interests in Missouri.

J. S. Alexander, of New York, is in Mexico examining properties in which he is interested.

Allen H. Rogers, of New York, has just returned from a short professional trip to Ontario.

S. W. Cohen, of the Kerr Lake Crown Reserve Mining Comany, Cobalt, Ont., is in New York.

W. J. Kerr, of Leadville, and J. H. Clay, of Silverton, Colo., are visiting the various mining camps of Mexico.

D. C. Beaman, of Denver, vice-president of the Colorado Fuel and Iron Company, is in Mexico on a pleasure trip.

W. H. Stevens, of the Tennessee Copper Company, has been examining mining properties in the Balsas district, Guerrero, Mexico.

Kent E. Keller, president of the Carrizo Copper Company, Jalisco, has returned to Mexico after some time in St. Louis on business.

Arthur Thacher and P. N. Moore, of St. Louis, have been making an extended trip through Mexico in the interest of Eastern parties.

S. M. Eccles, vice-president of the American Smelting and Refining Company has returned to New York after a tour of the company's properties in Mexico.

Mark R. Lamb, Guanajuato, Mexico, has retired from his engagement with Chas. Butters & Co., and now represents the Moore Filter Company in Mexico.

W. C. Potter, head of the American Smelting and Refining Company's interests in Mexico has returned to that country after a flying business trip to New York.

J. E. Spurr has gone to Matehuala, San Luis Potosi, Mexico, to make a geological examination of the Cobriza mine for its owner, the Compañia Metallurgica Nacional.

H. A. Wheeler, of St. Louis, has returned from New Mexico, where he examined some copper properties in the Burro Mountain district for St. Louis interests.

John Hays Hammond is recovering from his recent illness, and a despatch from San Francisco reports that he will come to New York about the end of March.

J. W. Bryant, of the Tyee Copper Company, Vancouver, B. C., is in Mexico studying the conditions, with a view of buying ores and shipping to his company's smelter.

Charles Briggs, president of the Calumet & Arizona Company, is at the property and will attend the annual meeting which will be held in Bisbee, Arizona, April 13 next.

F. L. Torres, of the Chihuahua plant of the American Smelting and Refining Company, is on a short visit to the United States. He will return to Mexico about the middle of April.

Guido Alberto, formerly with the Societa Metallurgica Italiana, has been appointed assistant manager of the mine and smelter of the Ollomont company, in the Pennine Alps, Italy.

B. B. Thayer, of New York, left for Butte, Mont., last week to make one of his periodical inspections of the property of the Amalgamated Copper Company. He will be absent about five weeks.

W. K. Field, formerly president of the New Pittsburg Coal Company, has been appointed vice-president of the Pittsburg Coal Company, in charge of all mining operations. His office will be in Pittsburg.

Thomas Hoatson is at Bisbee, Arizona, to attend the annual meeting of the Calumet & Arizona Mining Company, and the Superior & Pittsburg Copper Company, in both of which he is a director.

Sydney E. Bretherton, general manager of the Great Western Gold Company, of Ingot, Cal., who has been visiting New York and Boston, started home for California this week, intending to visit St. Louis on the way.

R. L. Lloyd, who has been in Chile for nearly two years as general manager of the Braden Copper Company, has returned to the United States and will engage in professional practice with headquarters at Salt Lake City, Utah.

W. A. Carlyle, consulting mining engineer, of London, who was formerly manager for the Rio Tinto Company, Spain, passed through New York last week on his way to London, returning from a professional engagement in British Columbia.

John B. Farish, consulting mining engineer, of New York, who has been in Colorado for some time past, has now gone to Mexico for a trip of two or three weeks, after which he will return to New York, where he will probably arrive in the early part of April.

S. C. Hazelton, formerly superintendent of the works of the United States Smelting Company, near Salt Lake City, Utah, has gone to Peru to take charge of the smeltery of the Peruvian Mining, Smelting and Refining Company at Rio Blanco, 50 miles from Lima.

Dr. Victor S. Clark, who is in Canada making a special investigation for the U. S. Department of Commerce and Labor, as to the working of the Lemieux industrial disputes act, has gone to Cobalt to note the operation of the law as regards miners' disputes.

Rensselaer H. Toll, formerly superintendent of the Mancos Consolidated Gold Mining and Development Company, and recently engaged in mining and milling in the Cripple Creek district, has removed to Denver, where he has opened an office as consulting engineer at 522 Mining Exchange.

T. Scott Anderson, consulting engineer, of Sheffield, England, is on his way to Russia to advise the Government respecting the erection of an electric smelting plant of 2000 h.p., for the purification of low-grade steel, and its conversion into metal of the best quality. The experiments will be made with the Anderson electric furnace.

The mayor of San Francisco has appointed a committee to investigate the smelter-smoke question and prepare a report to be presented to the San Francisco Board of Supervisors, in order to prevent the board from passing an ordinance detrimental to the erection of the San Bruno smelter by the Guggenheim interests. Charles G. Yale, of San Francisco, is in direct charge of the preparation of the report.

B. F. Jones, president of the Miners' Institute of America, was in conference last week with the officials of the Technologic branch of the U. S. Geological Survey for the purpose of gaining information concerning the mining laws in operation in European countries, and also to discuss in a general way the possibilities of providing for the diminution of mine accidents. Mr. Jones represented the State mine inspector of Pennsylvania.

J. M. Boutwell, who last year had charge of the Geological Survey statistical work on the production of zinc, lead and quicksilver in the United States, has relinquished this in order to devote his entire time to mining geology. Mr. Boutwell recently returned from an inspection of the Park City mining district, Utah, where he obtained the latest information regarding important recent developments. A complete report of this district will be ready for issuance at an early date.

Obituary

Jesse B. Price, mining engineer, of the Pittsburg Gold Mining Company, at Darrington, Wash., was killed at the mine, March 4, by J. H. Jahn, of Seattle, in a quarrel over the ownership of the mine.

Matthew McClung, superintendent of the Joliet blast furnaces of the Illinois Steel Company, died March 3, of blood poisoning. He was born in Knoxville, Tenn., 36 years ago, and was a graduate of Lehigh University.

George C. Converse, one of the best known authorities in the manufacture of zinc in this country and general superintendent of all the plants of the New Jersey Zinc Company, with headquarters at Bethlehem, Penn., died suddenly March 10 while on board a vessel en route from Alexandria for Naples, Italy. Mr. Converse was 53 years old and was educated at Lehigh University. He and his family went abroad a month ago in search of health.

Societies and Technical Schools

Crucible Club—This club, an organization of the chemists of blast furnaces and cement works in Southern Ohio and adjacent territory, held a meeting at Jackson, O., Feb. 29, when papers were presented by John Blank, of the Superior Portland Cement Company, on "The Chemistry of Portland Cement," and by Guy S. LaForge, of the Ironton Portland Cement Company, on "The Determination of Iron in Portland Cement by Sodium Thiosulphate." Several new members were elected. The next meeting will be held March 28, at Wellston, O.

Industrial

The A. Leschen & Sons Rope Company, St. Louis, gives notice that it has moved its Denver office and warehouse to Nos. 1649 and 1651 Wazee street.

The Ridgway Dynamo and Engine Company, Ridgway, Penn., has opened a district sales office at 907 Andrews building, Cincinnati, Ohio, with Geo. W. Euker in charge as manager.

The William B. Pollock Company, Youngstown, Ohio, recently made a shipment of 28 hot-metal cars of 40 tons capacity each to the Duquesne works of the Carnegie Steel Company. These are said to be the largest cars now in use for such service.

The International High Speed Steel Company, Franklin Square, New York, announces that it will offer to supply high-grade drill steel, both hollow and solid, free of charge to all competitors entering the drilling contest soon to be held at Cripple Creek, Colo.

The Storm King Stone Company has closed a contract with the Mashek Engineering Company, New York, for a 1000-cu.yd. per day stone-crushing plant, to be built at Storm King mountain on the Hudson river. The contract calls for the complete plant to be turned over to the owners in operation.

George B. Carr, vice-president of the Dearborn Drug and Chemical Works, Chicago, is on a trip to the City of Mexico. John W. Brashears, who has been first assistant to W. A. Converse, chemical director of the Dearborn Drug and Chemical Works, in charge of the analytical laboratories, has been appointed assistant superintendent of the manufacturing department.

The Jacobson Machine Manufacturing Company, Warren, Penn., has recently established a Southern office at Atlanta, Ga., at which point it will carry a full stock of the line of gas and gasolene engines, manufactured by that concern; also a stock of repair parts. This business will be in charge of C. R. Morrison, who has for some time been connected with the company.

During January, the Duquesne steel foundry, which operates a large plant in the Pittsburg district, decided to adopt gas power to operate the works, formerly driven by steam. The initial equipment will consist of a 400-h.p. Westinghouse gas engine of the three-cylinder vertical inclosed type, direct connected to a 240-kw. generator, which will serve the various motor drives around the plant. The plant will operate on natural gas.

The Barrett Manufacturing Company, 17 Battery place, New York, is operating the feldspar mine near Ticonderoga, which formerly was worked by the International Mineral Company. The Barrett company is using the mineral in the manufacture of its "Amatite" roofing. This roofing is a tar and felt composition, like the well-known "Black Diamond," with the difference that the surface is coated with crushed feldspar (in which a little mica is naturally mixed), making an economical roofing ready to lay.

G. W. McClure, Son & Company, Bessemer building, Pittsburg, have recently received a contract from the Tennessee Coal, Iron and Railroad Company, Birmingham, Ala., for seven McClure three-pass hot blast stoves, 21 ft. in diameter by 100 ft. high, on which work will be commenced at once. They have also secured a contract for remodeling and re-lining Belmont furnace of the Wheeling Steel and Iron Company, Wheeling, W. Va.; also for re-lining the Martin's Ferry, Ohio, furnace of the same company.

The Continuous Zinc Furnace Company, Hartford, Conn., has been organized under a Connecticut charter, with an authorized capital stock of $125,000, to develop a process for the reduction of zinc from the ore in large units in the electric furnace. Woolsey McA. Johnson, Hartford, is the president; Ephraim Williams, New York, vice-president, and Jarvis McA. Johnson, Hartford, secretary and treasurer. The president of the company, who is the inventor of the new process, has been experimenting for some time in developing the process, and is now building an experimental plant at Hartford to test out on a large scale a theoretical conception that has already been tried in the laboratory.

Trade Catalogs

Receipt is acknowledged of the following trade catalogs and circulars:

George W. Jackson, Inc., 46 Wall street, New York City. Steel Sheeting. Pp. 70, illustrated, paper, 7x10 inches.

Western Electric Company, Chicago, Ill. Bulletin No. 5352. Fan Motors. Pp. 44, indexed, illustrated; paper, 7x9¼ in.; 1908.

Craig Ridgway & Son, Coatesville, Penn. "Perfection" Water Wheel. Pp. 112. The Ridgway Duplex Jet Water Wheel. Pp. 32. Illustrated, paper, 6x9 in.

Telgmann & Torka, Inc., 703 Call building, San Francisco, Cal. Instruments of Precision—Astronomical, Engineering and Mining. Pp. 16, illustrated, paper, 6¼x 9¼ inches.

Western Electric Company, Chicago and New York. Supplies. Pp. 838, indexed, illustrated; cloth, 7½x10½ in. 1908. The size of this elaborate catalog is an indication of the great extent and variety of electrical apparatus now in use.

Construction News

Barstow, California—The Fremont Mining and Milling Company is arranging to put in machinery. C. W. Monaghan, Needles, Cal., is president.

Straight Creek, Kentucky—The Straight Creek Colliery Company is arranging to put in a coal-mining plant. L. W. Farmer, Barboursville, Ky., is general manager.

Westernport, Maryland—The Western Maryland Coal Company is arranging to put in coal-mining plant next summer. M. P. Gannon, Westernport, Md., is secretary and treasurer.

Moundsville, West Virginia—The Riverside Coal and Coke Company will soon begin to open a coal mine. Oliver K. Ward, Moundsville, W. Va., is directing the enterprise.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Denver, Salt Lake City, San Francisco and Toronto

REVIEWS OF IMPORTANT EVENTS

San Francisco

March 11—As has been stated in the ENGINEERING AND MINING JOURNAL, the California Supreme Court has decided that no license or permit granted any one for mining by the hydraulic process would have any effect whatever on the State courts, and could not authorize a miner to do any injury to the streams; and that notwithstanding the permit, a court might enjoin a hydraulic mine from operation. In view of this decision the Executive Committee of the Anti-Débris Association at its last meeting in Sacramento decided to proceed vigorously against all hydraulic mines in the drainage basins of the Sacramento and San Joaquin rivers, where there is evidence satisfactory to their agents of the inefficiency of the débris dams. This course of action was to have been expected after the decision was rendered, as the Anti-Débris Association had always contended that the Commission's license did not bar action by the courts, while the miners contended that it did. The legal decision on this point being against the miners, their old enemies will now renew their activity in bringing injunctions in local courts. Under such circumstances there is little or no encouragement to carry on hydraulic mining in the area of the State affected by the Caminetti act.

At the same meeting at which it was decided to proceed against hydraulic miners as stated above, a report was received from Otto Von Geldern, a civil engineer who was employed to look over the dredge-mining field at Oroville, Butte county, to see how the operations were conducted and advise the Association whether dredges could be landlocked so as to prevent future damage. He submitted a report to the association which was joined in by Guy McMurty, county surveyor of Sutter, and they both stated that the dredge miners at a practically small expense, could so arrange matters as to prevent any injury to the streams.

The Board of Supervisors of San Mateo county, adjoining the city and county of San Francisco, has adopted an ordinance regulating and licensing the operations of smelters and providing for their supervision, which is intended solely to prevent the completion of the Selby smelter at Point San Bruno. While it professes to regulate and license smelters it virtually prohibits their operation in San Mateo county, since the Selby Smelting and Lead Company could not carry on work under its provisions. At least they will not attempt to do so. The ordinance is based, it is claimed, on the English law adopted in 1906, which provides for the escape of fumes from plants manufacturing sulphuric acid. These plants, in England, are operated in large cities, and a smaller quantity of gas or fumes is allowed to escape than would be allowed in sparsely settled regions. But even in this English law there is no such provision as there is in the San Mateo county ordinance, that only 1½ grains of sulphur trioxide or sulphuric anhydride per cubic foot of smoke, gases, or fumes, shall be allowed to escape into the free atmosphere. After the San Mateo supervisors adopted this ordinance, efforts were made to get the San Francisco supervisors to adopt a similar one. No smelter is projected in the latter county, but it was argued that the fumes of the smelter in San Mateo county might injure the vegetation in Golden Gate Park, San Francisco. The mayor of San Francisco has appointed a committee of citizens to report to the supervisor as to damage liable to be done in case the Selby smelter at San Bruno is put in operation.

At Lane's Wells, some 20 miles north of Barstow in San Bernardino county, some high-grade ore has been found in the Fremont quartz group, and good ore has also been taken out of the old Discovery claim.

Salt Lake City

March 13—A New York syndicate has closed a deal for the purchase of the Century mine in the Park Valley mining district in Box Elder county, and will undertake to open the property and operate it on an elaborate scale. The mine has been a dividend payer in the past, and is equipped with a good milling plant. Among the improvements planned is the installation of an electric-power plant.

Judgment by default has been entered in the district court against the Honorine Mining and Milling Company for sums aggregating $232,296 on notes held against those corporations. The Honerine properties are located at Stockton and are well equipped with power and other equipment, including a mill having a capacity of 300 tons of ore per day.

It has been officially stated from the offices of the Utah Copper Company that dividend payments will begin about next July and that the first will be a quarterly dividend of 50c. per share. The company is producing copper, it is said, at the rate of 40,000,000 lb. annually.

The American Smelting and Refining Company has had a difficult time in keeping its lead smelter at Murray in commission on account of the slackening up in the receipts of lead ores. Producers determined some time ago to refuse to ship until the metal prices increased and the smelting company reduced its treatment charges to somewhere near the tariff in force last year. As a result of this action on the part of producers, who are members of the Utah Mine Owners' Association, the smelter has been operating with as few as two furnaces.

The Utah Consolidated Mining Company is shipping between 700 and 800 tons of ore per day from its mine in Bingham to the Garfield smelter of the American Smelting and Refining Company. It is said that, as the contract made with the American company is a very satisfactory one, the Utah Consolidated company expects to produce copper just about as cheaply as it would have done had it continued to operate its own smeltery.

A reorganization of the Weimer Copper Company is to be effected in a few days. This company owns a large copper property in Lemhi county, Idaho; considerable ore was shipped from this mine to the Salt Lake valley smelters last year. But when the panic came on last autumn, shipments were ordered stopped. Development continued until the treasury became short of funds.

Plans are being worked out for a consolidation of the Bingham Consolidated properties in Bingham and Tintic, with those of the Ohio Copper Company, which owns the Ohio copper mine in Bingham. It is proposed to increase the capital stock of the Ohio company and to exchange the new stock for the Bingham Consolidated holdings, the latter to become the property of the Ohio company. The Bingham Consolidated properties are to be turned in free of any indebtedness and in addition, it is understood, $1,000,000 is to be paid into the treasury of the Ohio company. The latter has a mill, which is designed to treat 2000 tons of ore per day, partially completed in Bingham.

The Tintic Smelting Company has closed several five-year contracts with some of the principal producers of the Tintic district. Construction work is progressing very favorably with every indication that the smelter will be blown in some time in May.

The case of the Black Rock Mining Company against the State of Utah, which was brought in the district court to test

the validity of the incorporation tax law passed by the last legislature, has been tried and has been decided by Judge Morris Ritchie in favor of the State. Suit was brought on the ground that the enforcement of the law inflicted double taxation on mining corporations, and was, therefore, unconstitutional. An appeal will be taken to the supreme court.

Indianapolis

March 16—A delegate convention of coal miners representing 350,000 organized mine workers of the United States and Canada was convened in extraordinary session in this city March 12. More than 1000 delegates are in attendance. At conferences held in this city in October, December, January and February the soft-coal operators and miners were unable to reach a preliminary agreement to issue a joint call for a wage conference, and at the last meeting, two weeks ago, they were still found to be in a deadlock.

One of the first acts of the convention was to send telegrams to all the leading operators in the Central district by the scale committee of the miners' organization inviting them to meet the miners of the district in another conference March 24. The replies thus far elicited show that Ohio operators are determined to defer such a conference until later in the year.

It is generally believed that Pennsylvania operators will coincide with the view of the Ohio operators and make no attempt to enter into a wage conference with the miners now in convention in this city. The refusal of the Ohio operators alone, however, would be sufficient to block the movement for a joint conference, as under the old rules the four States must be unanimous before a joint conference can be called.

The miners in convention have not yet settled upon what course to pursue and will not do so until after receiving replies from the operators from the four competitive States. There is little likelihood of the convention adopting the policy of making contracts only by competitive districts. There is a strong hope that the operators of Ohio, Illinois and Pennsylvania will join with Indiana within the next two weeks and indicate their willingness to meet the miners in joint wage conference and on that initiative ask that the mines be kept in operation after April 1, pending a settlement which would be retroactive. On the other hand a general walkout or suspension is looked for after April 1, if the operators do not meet with the miners in joint conference previous to that date.

Denver

March 13—The fight for the control of the El Paso Consolidated Gold Mining Company, of Cripple Creek, culminated at the stockholders' meeting at Colorado Springs yesterday, when S. S. Bernard, as president, and the old board of directors were re-elected. Mr. Bernard defeated A. L. Burris by 250,000 votes; 2,254,004 shares out of an issued stock of 2,450,000 were represented. The fight has been most bitterly contested.

By the arrest of H. H. Paine, a member of the London Stock Exchange, and director of the Trans-continental Tunnel and Mining Company, known here as the Vidler tunnel project, on a charge of misrepresentation of values of the vein and orebodies, an unfortunate scandal has been precipitated. The promoter, Rees C. Vidler, has disappeared and is not to be found. The company was capitalized at $3,000,000, its purpose being to drive a tunnel about 7000 ft. in length, through the continental divide at Argentine pass, near Georgetown, to cut at depth a number (stated at 100) of silver and lead-bearing veins, and also to be used as a railway tunnel, which it was stated in the prospectus, would shorten several existing lines. The promoter, Vidler, was the president, and in his report for March, 1906, he promised the stockholders a yearly revenue from the tunnel, when finished, of $2,500,000. About 4000 ft. of the tunnel had been completed, a mill erected, and about $250,000 spent, when not having any returns from the enormous bodies of pay ore reported as having been opened, an independent Denver engineer was commissioned to investigate, and the upshot of the affair was that the ore in sight was found to be ore in imagination, and the revenues, which were to be received from the railways, myths. Most of the money was furnished and lost by members in London of the Christian Science Church, of which the promoter and the English directors were prominent members.

Goldfield

March 10—During the labor trouble in Goldfield not much ore was mined, but now most of the mines and leases have all the men they need and soon the district should be producing a large tonnage.

At present the Nevada Goldfield Reduction Company's milling plant is treating approximately 100 tons of ore per day. This plant consists of 20 stamps, fowllowed by tube-mill crushing; the separated sands are leached and the slimes treated in vacuum filters. The plant is successfully treating both oxidized and sulphide ores of the district, and is always operating on a mixed product from several properties. The company's combined sampler and mill is the largest operating plant in the district and is receiving ores of value varying from $20 gold per ton to over $300. These ores are being received from the Florence, Jumbo, Mohawk, Combination Fraction, Sandstorm mines and some ores from other districts.

The Combination mill of the Goldfield Consolidated Mines Company, is next in importance and is operating along about the same lines as the Nevada Goldfield Reduction Company's mill. Grading for the large milling plant of the Consolidated Mines Company is now being carried on. The Florence Goldfield Mining Company's mill is not yet completed.

Toronto, Ont.

March 10—Chief Justice Sir William Meredith delivered judgment in Toronto, on Feb. 28, in the lawsuit over the Lawson mine, Cobalt, involving a property valued at $7,500,000. The decision was in favor of the plaintiffs, the Lawson Mine Company, and directed that the defendants, Thomas Crawford and S. R. Clarke, must carry out an agreement made by them on April 3, 1907, and transfer to the company one-fourth interest in the mine owned by them. The plea that they entered into the agreement without thoroughly understanding it, and that it was void on a technicality, was overruled. The case will probably be appealed.

John Retallack, of Kaslo, B. C., and Louis Pratt, of London, Eng., recently presented petitions to the Canadian Government from the Boards of Trade and owners of lead mines in British Columbia asking for the renewal, for another term of five years, of the bounty on lead, which expires in June, 1908. The bounty, which depended upon the price of lead in England, was largely inoperative on account of the high price to which lead rose, and consequently only about $750,000 of the $2,500,000 appropriated will have been expended when the bounty ceases on June 30, 1908. The petitioners ask for a fresh appropriation of $2,500,000, the bounty, at the rate of 75c. per 100 lb., to begin when the English price is £14 10s. per long ton and to cease when it reaches £18.

At the annual meeting of shareholders of the Larder Lake Proprietary Goldfields, held in Toronto recently, the directors' report stated that the option given to the Canada Mines Company had expired. A proposal to lease the property for 99 years had been received and was under consideration, as was also an offer for a large block of the treasury stock. The amount expended on plant and development work was $48,578.

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Alabama

CLAY COUNTY

Southern States Smelting Company—This company proposes to put up a 60-ton smelting plant for copper at its pyrites mine at Zell, on the Atlanta, Birmingham & Atlantic road. The office of the company is at Birmingham, Alabama.

Alaska

FAIRBANKS DISTRICT

A despatch from Fairbanks, Alaska, March 15, says: "Members of the Western Federation of Miners engaged in a riot today. They threatened men going out on the train to the creek to work and prevented railroad men from loading freight on the train. Shots were fired, but no one was injured except through being clubbed. Tom Steffensen, organizer and leader of the Western Federation; W. E. Preisley, editor of the miners' paper, and Frank Cullen, secretary of the local union, were arrested and sent to jail in default of bail."

Arizona

COCHISE COUNTY

Tombstone Consolidated Mining Company—The first consignment of new Prescott pumps is being set up on the 1000-ft. level of the big shaft. The two pumps to be installed in the station will have a capacity of 1200 gal. per minute directly to the surface. About 4,500,000 gal. are handled per day, and the extra capacity is intended to be used only in an emergency.

YAVAPAI COUNTY

Redman Mining, Milling and Smelting Company—This company is erecting a 10-stamp mill on its property near McCabe.

Monica—At this mine near Kirkland, the new 10-stamp mill is complete and will be started in a few days. A large amount of ore is on the dump awaiting treatment.

Kinney Group—This group of mines is again being operated by John Kinney. A body of ore is exposed and development work is in progress. This group is situated in the Big Bug mining district near Big Bug post office and upon the line of the Prescott & Eastern railway.

Octave Mining Company—This company held its annual meeting of stockholders in Phœnix, on March 9. The stockholders authorized the directors to add 40 stamps to the mill. The mill now has 40 stamps running steadily.

Big Stick Mining Company—This company has purchased the 20-stamp mill at the Sultan mine, on the Santa Maria river, and will remove it to its property about six miles farther up the river in the Eureka mining district, about 17 miles west of Hillside.

Mt. Elliott Consolidated Mining Company—This company shipped about $7000 in bullion to the mint last month. Its mines are near McCabe. The 10-stamp mill operates one shift per day.

California

AMADOR COUNTY

Bunker Hill—At this property, E. H. Harrington superintendent, the ore is now yielding $5 per ton and it has for several months past, permitting dividends to be paid.

Farrell—This mine, at Middle Bar, has been leased by P. Leonerio, who is now working it.

Plymouth Consolidated—A company has been formed to open up this old mine.

CALAVERAS COUNTY

Utica Mining Company—A large force of men has been put on at this property, Angels, and the shaft has been repaired so that extensive developments are under way on the lower levels.

EL DORADO COUNTY

Baltic—At this mine (formerly known as the Melton) the new tunnel has struck through into the old works. Extensive operations may now be carried on.

INYO COUNTY

Four Metals Mining Company—At this property, Cactus Flat, a whim has been put in over the shaft in which there is a promising ledge at 200 ft. depth.

Roosevelt Oil Company—This company, near Cactus Flat, after having reached a depth of 2712 ft. in its well, has quit work, no indications of oil having been met.

KERN COUNTY

Queen Esther—This mine, near Mohave, where 40 men are employed, is the only one in the vicinity which has been in continuous operation for the past six years.

Yellow Aster—This property at Randsburg is again being worked to its full capacity and a large ore extraction is being made.

MADERA COUNTY

Gambetta—It has been expected that steps would be taken to reopen this old mine at Grub Gulch, but it has now been decided to abandon the work.

MARIPOSA COUNTY

Exchequer—The development of the property is to be commenced on a large scale at once, and the water is now ready for power and light purposes.

Mount Gaines—The installation of the electric-power line to this mine from the power plant at Exchequer is completed, and the mine will shortly commence operations again.

NEVADA COUNTY

Leduc Mining Company—This company, B. A. Penhall manager, is to run a long tunnel on the old Leduc ranch, near Osborn hill, and new machinery will shortly be installed.

PLACER COUNTY

A Du Bois suction dredge of the pattern used in the headwaters of the Sacramento river, has been launched at Cash Rock, at the mouth of the Dardanelles cañon.

Bellevue—This mine at Ophir has been bonded to men from Reno, Nev., who have commenced to sink and develop the vein. R. J. Trimble is manager.

PLUMAS COUNTY

Arcadia—In this mine, at the head of North cañon, D. McIntyre owner, some very high-grade quartz is being taken out.

SAN BERNARDINO COUNTY

Fremont—At these mines near Lane's Wells, north of Barstow, C. W. Monaghan of Needles, president, some very high-grade ore has been found and preparations are being made to put in machinery.

SIERRA COUNTY

Alleghany—This hydraulic mine, W. W. Tiner superintendent, is operating at Chipps Flat under a Government permit. The storage reservoir for débris is in Kanaka Flat.

Rainbow—At this mine near Alleghany, Murdock Morrison superintendent, 20 men are employed and the mill is kept running steadily on high-grade ore.

SISKIYOU COUNTY

Yellow Butte—This copper property, 12 miles from Edgewood, has commenced shipping ore to the Mammoth smelter at Kennett. L. D. Ball is superintendent and part owner.

TEHAMA COUNTY

California & Massachusetts Copper Mining Company—This company, owning the Tom Head mines, is prospecting by means of a new drift.

Colorado

DOLORES COUNTY—RICO

Magnetic Separation of the Zinc Ores—J. M. McClave, former manager of the Colorado Zinc Works at Denver, now metallurgist of the United Rico Mines Company is testing the zinc-blende ores of the company by magnetic separation. A number of years ago before the consolidation of the properties now owned by the United Rico Mines Company, a similar test was made on a large scale and a product assaying 54 per cent. zinc was obtained. Mr. McClave has overhauled the old roaster and the magnetic separators, confident that even with such equipment he can make a commercial product on the ore from the mines in the Atlantic Cable area. The first test is on accumulated middlings, averaging 32 per cent. zinc, made by wet concentration from the silicious ores of Dolores mountain. From these he expects to make a product assaying at least 45 per cent. zinc.

Potter Tunnel—Recent sampling of this adit in the northern part of the Atlantic Cable area has disclosed the presence of chalcopyrite throughout the entire length of the adit and in the south and north crosscuts. In a stratum of garnet rock the chalcopyrite is present in such quantities that rough hand sorting would give a shipping product. Assays made at the time the tunnel was driven were from samples taken from the entire breast after each shot. They showed from a trace to 20 per cent. copper, but were too variable to indicate the true condition of the mine. One geological condition here is similar to that of Bingham cañon, Utah, where the copper occurs disseminated through monzonite. The maps in the Rico folio issued by the United States Geological Survey show that a very extensive body of monzonite lies just ahead of the Potter tunnel and that monzonite porphyry is abundant throughout the entire area.

Idaho

LATAH COUNTY

Mountain Gulch Mining and Milling Company—Machinery, consisting of a Huntingdon mill, which has been substituted for a three-stamp addition, engine, boiler, etc., has now been laid down at Harvard and will be set up at once. The ore, which is free milling was found too friable to be handled with stamps. This is one of the promising mines of the Hoodoo district, where preparations are now being widely begun for an active season. When the present plant is working with a full crew it will reduce 22 tons daily.

NEZ PERCES COUNTY

Ozark Mining and Milling Company—Power drills, air compressor and other machinery have been sent to the Pierce City district, preparatory to beginning operations at once. This is the first power outfit ever sent into Pierce City and will be used on the Wild Rose group, which has been under development all winter. A 1200-ft. adit is now being driven to tap a ledge at a depth of 500 feet.

SHOSHONE COUNTY

Charles Dickens—Rich ore carrying native silver has been found in the ore shoot at this mine near Wallace. The shoot was at first thought to be a new one, the formation here tending to comparatively small and isolated bodies of ore; further development, however, has led to the conclusion that it is but an extension of the orebody already worked and from which the company has been shipping. New machinery, including vanners, Wilfley tables, etc., to replace that injured and destroyed in the recent fire, is now at the mine. Work has progressed steadily on the new mill building and the management states that the concentrator will be in operation shortly.

Indiana

Vandalia Coal Company—A report just published shows that the coal output for the six months ending Dec. 31 showed an increase over the preceding six months of 312,000 tons. The total output for 1907 was 2,100,000 tons. The company met the semi-annual interest on its bonds amounting to $84,000 and paid the regular quarterly instalment of the sinking fund of $25,000. The authorized bond issue is $3,000,000, of which $215,000 has been redeemed in the last two years.

Michigan

COPPER

Franklin—The fire which was discovered at the 28th level of No. 5 shaft, early last week, soon burned itself out doing no material damage. Production was not seriously interfered with, as only a small portion of rock comes from the old mine; the principal production comes from the Pewabic lode on the Franklin, Jr. tract.

Arcadain—The new exploratory shaft is down about 200 ft. and diamond drilling is to be carried on, from the bottom, east to the Great Eastern sandstone. After this has been completed the management will probably crosscut west to the old workings. In this maner a complete cross section of the entire tract will be obtained and the several known lodes will be penetrated.

Montana

BUTTE DISTRICT

Since the re-opening of the Butte mines there has been a great influx of miners and other workmen. Many of the latter are leaving the city, disappointed because they were not given work. It seems that only experienced miners, machinists, etc., are being employed.

Davis-Daly—Another vein has been cut in the Colorado; it was encountered in an east drift on the 1000-ft. level. As yet the extent of the vein is not known, but it is stated that the ore runs high in zinc and carries no other valuable minerals. Like the one cut south of the shaft, this vein strikes northwest and southeast.

Raven Mining Company—New machinery, capable of operating to a depth of 2500 ft., is being installed. During this work the shaft is being put in first-class condition. The vein on the 900, recently encountered, shows a decided improvement over its appearance on the 700. The shaft on the property is inclined and, as the vein appears to be taking a steeper pitch as depth is attained, it is possible that it will be sunk vertically below the 1100. A crosscut is now being run on the 1100 with a view to opening the veins on this level.

Butte-Knickerbocker--Negotiations were closed a few days ago by which this company, which was organized in Butte about a year ago, has materially increased its holdings. It has acquired 14 claims in the north Walkerville district, known as the "Determination group," lying immediately west of the Butte and Bradley group, and but a short distance northwest of the Butte & Bacorn property. It has also secured possession of the "Golden Leaf" group of claims at Bannack, in Beaverhead county. This property is an old gold producer and is said to contain a large quantity of medium and low-grade gold ore.

SANDERS COUNTY

Montana Mammoth—Gold ore has been encountered at a distance of 200 ft. from the portal of the adit. The gold-bearing rock is an oxide of manganese, very black and heavy, occurring in masses throughout the face of the adit, which follows the footwall of the vein. The wall is well defined with a continuous streak of talc, which carries small amounts of gold and silver.

Nevada

ESMERALDA COUNTY—GOLDFIELD

The output of the different mills at Goldfield and the shipments during February are as follows: Western Ore Purchasing Company, 556 tons; Combination mill, 2300 tons; Kinkead mill, Nevada-Goldfield Reduction Works, 1119 tons; total output, 4395 tons. The Combination mill treated ore from the Combination mine; the Kinkead mill treated ore both from Consolidated mines and from the Garrett & Prior's lease on the Kendall mine. *Western Ore Purchasing Company*—This company received from the Mohawk-Combination, 72 tons; Florence Annex, 147; Black Butte, 15; Daisy, 58; Diamond Queen, 11; Great Western, 33; various dumps, 220 tons. *Nevada-Goldfield Reduction Works*—This company received from the Mohawk, 160 tons; Little Florence, 55; Florence Annex, 20; Florence Gem, 12; Sandstorm lease, 250; Jumbo dump, 32; Jumbo Mining, 350; Combination Fraction, 240 tons.

The Western Federation of miners has accepted the Tonopah scale of wages offered by certain leasers. The union miners will work alongside non-union miners and so local No. 220 accepts the open-shop principles at Goldfield. The Mine Owners' Association refuses to pay the Tonopah scale of wages.

Jumbo Extension—The date for hearing arguments on the injunction obtained by the Goldfield Consolidated Mines Company against this company has been postponed indefinitely.

Daisy—A heavy flow of water has been cut in the south crosscut on the 400-ft. level of the Truitt shaft. This has caused a temporary suspension of work at that shaft, but work continues at the company's shaft. Two pumps have been installed at the Truitt shaft.

American Mill—Fred H. Vahrenkamp, who has taken charge of this mill, states that five more stamps will be added and the capacity of the mill increased to 100 tons per day.

Rogers-Syndicate Lease—It is reported that a strike of rich ore has been made on the 400-ft. level in a crosscut driven from the main east and west drift. This lease has 132 days yet to run; 50 men are working at the property.

Florence—This company has posted a second quarterly dividend of 10c. per share payable to stockholders of record of April 2. The full amount of the dividend is $105,000. The company is said to have in its treasury $250,000 besides the money for this dividend. George Wingfield has not been re-elected as director. Mrs. A. D. Parker, wife of the vice-president of the company, has been elected in Wingfield's place.

NYE COUNTY—TONOPAH

The ore shipments from the Tonopah mines for the week, ending March 5, as reported by the Western Ore Purchasing Company, consisted of 110 tons from the MacNamara mine, 145 from the Midway, 144 from the Tonopah Extension, and 43 tons from the West End mine. The Tonopah company sent 4850 tons to the mill; the Belmont, 650; the Montana-Tonopah, 1000; the Jim Butler, 374; and the North Star, 150 tons; making the total shipments for the week, 7466 tons.

Tonopah—The usual development work is being done; ore is being mined on all levels above the 600-ft. in both the Silver Top and Mizpah claims. The crosscut on the 900-ft. level is being advanced. The regular amount of ore is being shipped to the mill.

North Star—Stoping continues in the 950-ft. level. The east drift on the 1050-ft. level, which follows the Mac Donald vein, is now 200 ft. long.

Tonopah Extension—The usual development work is being done on the different levels above the 600-ft. Ore shipments are being curtailed as more development is being done in order to block out ore for the mill.

Jim Butler—The principal work is confined to the Fraction and Wandering Boy claims. The east drift from the Fraction No. 1 shaft is being driven ahead to connect with a raise, which is being driven from the 300-ft. level so as to give better ventilation. The north crosscut from Fraction No. 1 shaft is 420 ft. long. Work has stopped in the Wandering Boy claim. Regular shipments at the rate of two 50-ton cars per day are being made to the Belmont mill.

Mac Namara—All the ore being shipped comes from the two raises on the 300-ft. level about 600 ft. west of the shaft. No. 2 raise is now 115 ft. high; No. 1 raise is 50 ft. high. These raises are 30 ft. apart and all the ground between them is being broken down and shipped.

West End—The usual amount of drifting and stoping is being done on the 400-ft. level, west of the shaft.

Montana—Development work is being done on the 2d, 3d, 4th and 5th levels. Ore is being stoped from the south vein and the Mac Donald vein on the 3rd level. On the 4th level ore is being stoped from the south vein and the Mac Donald vein while some good milling ore is also being mined from the A. B. K. vein in the west crosscut, 400 ft. north of the shaft. On the 665-ft. or intermediate level between the 4th and 5th levels ore is being mined.

Midway—Much development work is being done on the lower levels. The east drift on the 835-ft. level is being advanced. The station at the bottom of the winze sunk from the 835-ft. level has been finished and a crosscut has been started toward the vein. Good ore is being extracted from the Brougher vein on the 300-ft., 400-ft. and 450-ft. level. Considerable prospecting is being done on the upper levels.

Belmont—The crosscuts on the different levels which are being driven to cut the Occidental and Nevada veins are being advanced. On the 800-ft. level stoping has begun on the Occidental vein. The usual tonnage of ore is being mined.

New Mexico

SOCORRO COUNTY

Top Mining Company—This company operating in the Mogollon district has opened up 18 ft. of ore on the 200-ft. level, this being the width of the vein. The value as in the rest of the district is about equally divided between silver and gold. The company is continuing the shaft down on the vein which is improving with depth. A new 25-h.p. plant has been installed.

Deadwood—Cleaveland and Weatherhead operating this property which is on the same vein as the Top, Confidence and Last Chance mines have completed about 1800 ft. of development work, and have opened up a large ore reserve, the ore being cut on three different levels. This property, as well as the Top and a number of other developed mines, will be compelled to put in their own mills unless someone builds a custom mill in the near future. The present treatment in the district is concentration and cyaniding.

Pennsylvania

BITUMINOUS COAL

Monongahela River Consolidated—The statement of this company for the first quarter of its current fiscal year, Nov. 1 to Jan. 31, is as follows:

	1907.	1908.	Changes
Earnings	$520,099	$590,012	I. $69,913
Charges	328,803	388,081	I. 59,278
Surplus	$191,296	$201,931	I. $10,635

The charges this year included $132,716 for depreciation of coal lands; $97,600 for depreciation of plant and equipment; $30,000 for taxes; $127,756 for interest on bonds. The total coal mined for the quarter was 1,941,007 tons, an increase of 394,445 tons over last year.

COKE

Brown Plant—Work has been started on this plant, near Bridgeport, owned by Harry Brown. The tract includes 1000 acres of coking coal, and it is stated that 700 ovens will be built.

Sherrick Brothers Company—This company has decided to begin work on its new plant at Crow's Ferry, near Point Marion. A quarry will be opened and all the stone used will be secured on the place. Machinery from some of the mines of the company not now operating will be moved there. Arrangements have

been made with the railroad company to extend the Cheat river siding to the field. The company will build at least 100 ovens this summer and continue, as needed. The coal will be shipped by rail and boat, as a tipple will be erected on the river bank, to take care of the river business.

South Dakota

LAWRENCE COUNTY

Anderson—A strike of $5-milling gold ore has been made in a tunnel in the vertical formation, and a shaft will be sunk to quartzite 50 ft. deep, in the flat formation.

Gold Queen—Plans are now being made to resume work within the next few weeks when the shaft, now 216 ft. deep, will be continued and the drifts on the 200-ft. level prosecuted.

Ground Hog—This mine will be operated in conjunction with the Gold Queen adjoining through a drift where good quartz has been found. The orebody is large and the walls have not yet been located.

Homestake—Additions are being made at the slime plant at Deadwood. Two more Merrill self-sluicing filter-presses are being installed, which will raise the daily capacity to considerably over 1600 tons of slimes; later it is the intention to build a wing to hold six more similar presses. The recovery on the slimes is slightly above 90c. per ton. Sinking in the Ellison shaft at Lead will be discontinued when 1725-ft. depth is reached. The shaft is now down 1700 ft. Drifting will be started from the present level after a sump is built. The Ellison is the deepest mine in the Hills.

Utah

IRON COUNTY

Jennie Gold Mining Company—This company, operating at Gold Springs, is actively developing its mine; the mill is turning out about $400 worth of gold bullion per day.

JUAB COUNTY

Opex—Officials of this company have expressed the opinion that they will soon be prepared to prove that one of the neighboring mining companies has been extracting ore from Opex territory. The main shaft of the Opex mine is 1400 ft. deep; it will be sunk to a depth of 2000 ft.

Swansea—The Tintic Smelting Company, which recently acquired a controlling interest in this property, is installing a large pump in the Swansea shaft, which will pump water to the Tintic Smelter.

Mammoth—This shaft, which is the deepest in the Tintic district, is now 2300 ft. deep. A shoot of ore was recently found at a depth of 2650 ft. as rich as any found elsewhere in the mine, a shipment having been made which assayed $2000 per ton in gold, silver and lead.

SUMMIT COUNTY

The ore shipped from Park City during the week ending March 13 amounted to 1,617,810 lb.; the Daly Judge shipped 508,000 lb.; the Silver King Coalition, 864,100; and the Daly West, 299,710 pounds.

Silver King Coalition—The Apex vein has been cut on the Alliance tunnel level of this property. The vein contains some high-grade, silver-lead ore.

Daly Judge—The electric haulage system at this property is giving splendid satisfaction; it is the first to be installed at Park City.

Ontario Drain Adit—The water in No. 3 shaft is about 170 ft. below the 1100-ft. level, and is receding at the rate of nearly 5 ft. per day. The management hopes to have the adit in operation about the latter part of May. The water level at several of the mines of Park City has been lowered, so that it is now possible to operate them at depths inaccessible since the caves occurred in the drain adit.

Canada

BRITISH COLUMBIA

Crow's Nest Pass Coal Company—The annual meeting was held in Toronto, March 10, when it was decided to reduce the number of directors from 15 to 9. The report for 1907 showed net profits of $382,986. This amount, together with $353,592 balance at the end of 1906 and 324,420, premiums on new stock, made a total of $1,060,998. Dividends of 10 per cent. were paid, which amounted to $355,178; $324,420 was transferred to reserve and a balance of $381,399 carried forward. The quantity of coal mined in 1907 was 981,939 tons, as against 806,901 tons in 1906, and the amount of coke produced was 231,368 tons, as against 213,295. During the year the company spent $493,818 in improvements. The new board of directors is as follows: G. G. S. Lindsey, president; Hon. Robt Jaffray, first vice-president; Sir Henry M. Pellatt, second vice-president; E. R. Wood, treasurer; E. C. Whitney, H. B. McGiverin, Col. W. P. Clough, Jay P. Graves and Elias Rogers. The selection of Col. Clough, of New York, is due to his being vice-president of the Northern Securities Company, which has large interests in the Crow's Nest Pass.

YUKON

Yukon Basin Gold Dredging Company—D. A. Matheson is at Whitehorse making preparation for dredge construction. The building of the hulls of the dredge and steamer will be begun as soon as spring opens, and the dredge will be forwarded to its destination on the Stewart river as soon as possible. The machinery is under contract at the Risdon Iron Works, San Francisco.

Mexico

CHIHUAHUA

Greene Gold-Silver Company—This company started up its 100-ton El Salto mill at Ocampo on March 1. The materials for the cyanide plant for the treatment of the tailings are on the ground and will be erected at once.

Rio Plata Mining Company—This company will build a 100-ton cyanide plant to treat the tailings from the concentrating plant at its Santa Barbara silver mine near Guazapares. The concentrates are shipped to El Paso.

DURANGO

La Purisima—This mine, better known as "La Bonanza," at Velardeña, is again taking out rich ore. The property has produced little or no ore during the last 15 years, but has long enjoyed a reputation for yielding rich ore in pockets.

MICHOACAN

Ario Copper Company—This company, which recently acquired the San Antonio and San Valantin mines has found silver ore in developing the old workings, and believes that this district, long known as a copper region, will soon produce chiefly silver.

OAXACA

Consolidated Metals Company—This company has moved its offices from Ocotlan to Taviche and has resumed the purchase of ores. It has also taken over the San Juan-Taviche & Oaxaca railroad and is pushing construction work and cleaning out cuts at various points.

SINALOA

La Dicha—This mine has been unwatered and examined, and E. E. Noons, formerly superintendent of the property is on the ground with instructions to keep the water down, pending reorganization of the company or the settlement of the difficulty among the stockholders.

Africa

TRANSVAAL

London despatches report that, under pressure exerted by the Transvaal Government, which is entitled to 60 per cent. of the company's output, the Premier Diamond Manufacturing Company has definitely refused to renew its agreement with the diamond syndicate. The Premier company announces that it will market its own output on the expiration this month of the present contract with the syndicate.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, March 18—The wage scale agreement continues to be the chief point of interest in the West. The Mine Workers' convention is still in session at Indianapolis. Telegrams were sent from the convention to the operators in the competitive States, asking for a general conference, but no satisfactory answers were received. The eastern Ohio district operators have voted not to go into a conference. It is said that the western Pennsylvania people will follow this action. The whole matter is uncertain, but most consumers are looking for a stoppage of mining on April 1, and are putting in stocks accordingly. Comments on the situation will be found on another page.

In the east the bituminous trade is quiet, and the demand for steam coal does not improve. The anthracite trade is dull, and many collieries have been put on short time. The coastwise trade is dead for the present.

Coal Traffic Notes

Tonnage originating on Pennsylvania railroad lines east of Pittsburg and Erie, year to March 7, in short tons:

	1907.	1908.	Changes.
Anthracite	960,292	941,086	D. 19,206
Bituminous	6,943,445	5,869,931	D. 1,073,514
Coke	2,598,507	1,302,635	D. 1,295,872
Total	10,502,244	8,113,652	D. 2,388,592

The largest proportional decrease was in coke, amounting to nearly one-half. The total decrease was 22.7 per cent.

Receipts of coal at Boston, two months ended Feb. 29, reported by Chamber of Commerce:

	1907.	1908.	Changes.
Anthracite	272,991	241,755	D. 31,236
Bituminous	368,573	493,503	I. 124,930
Total domestic	641,564	735,258	I. 93,694
Foreign	81,953	97,602	I. 15,649
Total	723,517	832,860	I. 109,343

The foreign coal is chiefly from Nova Scotia, with a little from Great Britain.

Coal and coke tonnage, Chesapeake & Ohio railway, seven months July 1-Jan. 31, short tons:

	Coal.	Coke.	Total.
New River	3,573,382	127,274	3,700,656
Kanawha	3,040,215	61,060	3,101,275
Kentucky	177,200	.....	177,200
Connecting lines	64,944	46,526	111,470
Total	6,855,741	234,860	7,090,601
Total, 1906	5,543,513	233,431	5,776,944

Deliveries to points west of mines, this year, 3,405,175 tons coal and 120,609 coke; points east, 1,023,660 tons coal and 67,725 coke; tidewater, 2,361,962 tons coal.

Shipments by Monongahela River Consolidated Coal and Coke Company, three months, Nov. 1 to Jan. 31:

	1907.	1908.	Changes.
River coal	1,093,666	1,523,765	I. 430,099
Railroad coal	452,896	417,242	D. 35,654
Total	1,546,562	1,941,007	I. 394,445

The increase this year was due chiefly to the unusual continuance of high water on the Ohio.

New York

Anthracite

March 18—Until April 1 there will be no business, to speak of, in prepared sizes. After that date it is problematical whether or not business will improve. Among the small steam coals, pea size is very short; the rest are in good supply. Prices are as follows: broken, $4.75; egg, stove and chestnut, $5; pea, $3.25@3.50; buckwheat No. 1, $2.75@3; buckwheat No. 2 or rice, $2.15@2.25; barley, $1.75; all f.o.b. New York harbor.

Bituminous

The soft-coal market is dull and no business is doing. The trade depression extends throughout New England and consumers are holding off persistently. In New York harbor business is nearly at a standstill and good grades of steam coal can be bought for $2.60 per ton.

Transportation from mines to tide is good and cars are in abundant supply. In the Coastwise trade vessels are plentiful, but are not in good demand. Freight rates are nominally quoted at 60@65c. per ton to points around the Cape.

Birmingham

March 16—Coal operations are slowly improving in Alabama, despite the fact that summer is approaching. There are, though, quite a number of coal mines still idle; but there is preparation for an immediate improvement in the output just as soon as the demand warrants it. No changes have been made in coal prices lately in this district. The coal miners sought other employment just as soon as mines shut down.

Coke shows a little improvement again with 100 more coke ovens being gotten ready to be fired up.

Chicago

March 16—Buying has somewhat increased in the last week because of the apprehensions of consumers of large amounts of coal that the supply from Middle-West mines will be cut off by labor troubles. The market, however, is far from being strong. Prepared sizes of Illinois and Indiana coals are especially weak owing to the approach of mild weather and the general tendency to use cheaper coals. Run-of-mine and screenings are fairly strong.

Illinois and Indiana lump or egg brings $1.90@2.40; run-of-mine, $1.70@1.80, and screenings, $1.30@1.40.

Eastern coals are dull also. Smokeless is quoted at $3.15@3.40 for Pocahontas and New River. Hocking brings $3.15; Pittsburg No. 8, for ¾-in., $2.65, and Youghiogheny $3.15 for ¾-in. gas.

Anthracite is very dull, both because of the weather and because of the expectation of discount prices in April.

Cleveland

March 16—Eastern Ohio coal operators were in session today and discussed the situation as it appears since the adjournment of the Indianapolis convention. President Goff of the Goff-Kirby Coal Company said tonight that the operators had taken no decisive action and would meet again shortly. Railroads running into Cleveland are buying coal in increased quantities. The railroads have been utilizing their empty cars for the purpose of storing coal for 30 days or more.

Indianapolis

Mine operators in Vigo and adjoining districts are operating their mines to their fullest capacity and the prospect is that March will be a record month in output. The larger part of the coal is going to Chicago and other points for storage there. Most of it is contract coal and prices are affected but little. The prospect for suspension April 1, is so strong that dealers and large consumers have asked for all the coal possible to be mined for them this month.

The Indiana operators have been willing from the beginning to sign the old contract for another two years. The output in the State in 1907 was upward of 14,000,000 tons, and it is understood the reports will show a net increase in the average earnings of the men, although 2080 men were added to the employees during the year.

Pittsburg

March 17—During the past week production of coal at the railroad mines was increased considerably, and all of the river mines were running. While consumption does not exceed 30 per cent. of the capacity of the railroad mines, nearly 75 per cent. of capacity is now being produced. This is due to what is regarded here as a certainty, that mining operations will be suspended on April 1 for from three to four weeks. Consumers are laying in an extra supply and producers are stocking some coal. Prices remain firm on a basis of $1.15 for mine-run coal at the mine on contract. A large shipment of river coal went to lower ports during the week.

Connellsville Coke—Coke prices seem to be weaker, but there is no demand of any consequence. The only contract of any importance was closed a few days ago. It calls for the delivery of 2000 tons of furnace coke monthly until July 1, and the price is said to have been $1.80 at ovens. For prompt shipment standard Connellsville furnace coke in small lots sold during the week at $1.70. It is doubtful if this price could be shaded. Foundry coke is still quoted at $2.25@2.40 for both spot shipment and on contract, but it might be possible to shade this rate. Of the 35,000 ovens in both of the Connellsville fields less than 15,000 are in operation. The *Courier*, in its weekly report, gives the production in both regions at 158,824 tons. The shipments amounted to 6817 cars, distributed as follows: To Pittsburg, 2970 cars; to points west of Connellsville, 3358 cars; to points east of Connellsville, 489 cars.

Foreign Coal Trade

Coal imports and exports in Belgium, month of January, metric tons:

Imports:	1907.	1908.	Changes.
Coal	411,275	365,223	D. 46,052
Coke	32,295	30,951	D. 1,344
Total	443,570	396,174	D. 47,396
Exports:			
Coal	376,170	364,084	D. 12,086
Coke	63,446	66,940	I. 3,494
Total	439,616	431,024	D. 8,592

Imports exceed exports by only 3954 tons in 1907. Exports this year were 34,850 tons greater than imports.

Coal mined in Great Britain for the full year was 251,050,809 long tons in 1906, and 267,828,276 tons in 1907; an increase of 16,777,467 tons, or 6.7 per cent. To the total in 1907 England contributed 187,383,346 tons; Wales, 40,252,178; Scotland, 40,092,548; Ireland, 99,704 tons.

The Crow's Nest Pass Coal Company, of British Columbia, makes the following statement for the past year:

	1906.	1907.	Changes.
Coal mined	806,901	981,939	I. 175,038
Coke made	213,295	231,368	I. 18,073

The increase in coal mined was 21.71 per cent., and in coke made it was 8.5 per cent.

Iron Trade Review

New York, March 18—There is little relief to the existing dullness in the iron and steel trades. In fact the general opinion is that, while February showed some improvement over January, March thus far has brought out less business than the preceding month.

In pig iron there has been less buying, and more shading of prices is reported. Many furnaces are maintaining the agreed quotations, but some appear to be looking for business at any price. Such demand as exists for pig iron is chiefly in small lots.

Finished material is also dull. A few contracts for structural steel have been closed; but others are held back in the hope of lower prices. Railroad work is not coming in, with the exception of a little bridge work, and some small orders for rails.

The advisory committee is meeting in New York this week. The questiton of reducing prices will be taken up, but it is hardly probable that any change will be made.

Baltimore

March 17—Included in imports for the week were 50 tons silicon-spiegel and 30 tons manganese ore. There were no arrivals of iron ore. Included in exports were 1259 tons steel billets and 335,191 lb. wire nails; also 500 cases, 129,517 lb. aluminum.

Birmingham

March 16—There is a steady shipment of pig iron from the Birmingham district, though in small lots. No. 3 furnace of the Republic Iron and Steel Company at Thomas, near here, has been blown out for repairs. It is understood that No. 2 furnace at the same place will shortly be put to work. No. 1 furnace resumed operations 10 days ago. There appears to be a little more confidence expressed by the Southern iron manufacturers, the inquiries coming to hand being an indication of a little better demand.

The steel plant at Ensley continues to be the busiest industrial center in the Birmingham district. There is but one out of five furnaces at Bessemer in operation. though the Woodward Iron Company near-by has two iron-makers going.

The machine shops and foundries appear to be running slow with a smaller force employed.

Chicago

March 16—Dullness continues to rule the iron market, with sales light and no tendency of either users or makers of iron to contract for future needs. Carload lots are about the only ones in demand. An order of 200 tons represents the limit of size under present conditions, which do not seem destined to improve soon. Hand-to-mouth buying is the rule.

Southern iron holds at $13 Birmingham for small lots, making the Chicago price $17.35. There is talk of sales at 50c.@$1 lower for a large lot, and a good-sized order doubtless could be placed at less than $13. But the large lots are not in demand. Northern iron brings $17.50, and Lake Superior charcoal is at $21.50.

Trade in iron and steel products is light, but seems to be improving. Coke brings $5.20 for the best Connellsville and is in plentiful supply.

Cleveland

March 16—With large stocks of ore on the lower lake docks, and in furnace yards, conservative vessel men are exerting all their influence to prevent boats from starting before June 1. This they believe will prevent rate slashing. Ore prices are unchanged.

Pig Iron—There is absolutely no business being done in pig iron at present. There are no evidences of cutting prices in the Cleveland district contrary rumors notwithstanding. There are not enough sales to make a price. For Cleveland delivery—charcoal iron being based on water freight rates—quotations are as follows: Bessemer $17@18; No. 1 foundry, $17.85; No. 2, $17.85; No. 3 $16.85; No. 2 Southern, $17@17.85; No. 2 $16@16.85; Lake Superior charcoal $22@23.

One furnace contract on coke for 50,000 tons, to cover four months, is said to be somewhat above current quotations, owing to special conditions attached thereto. High-grade spot foundry coke is quoted at $2.30@2.50 and spot furnace coke at $1.70@1.80 per ton.

Philadelphia

March 18—Pennsylvania pig-iron makers have been very slow to respond in their quotations to the weakening influences at work elsewhere, and here as well. Considerable foundry and forge iron has been contracted for during the past week at attractive concessions, and more business will be done before Saturday on the same basis. But there is no general buying nor are the present reduced quotations regarded as final by consumers. Large pipe-iron purchases have been quietly made from Southern producers at a farther concession.

Steel Billets—Sales of billets have been very light.

Bars—The shading of prices on comparatively small lots shows the condition of the bar-iron market. Very few mills are sure of running more than a few days ahead. Store sales are naturally larger. The base price is 1.68c. tidewater.

Pittsburg

March 17—The past week has been the dullest of the year and there does not seem to be any immediate prospect of an

improvement. The only really strong lines are tin-plate and wire products. The tin-plate mills are being operated to more than three-fourths capacity which will be considerably increased next week, and the wire mills are running to about two-thirds capacity.

The bi-monthly settlements under the annual wage agreement with the Amalgamated Association, based on actual sales of bar iron, tin-plate and sheets in January and February resulted in reductions in wages for the workers in the three lines.

There is no improvement in the operation of the iron and steel mills this week. The Carnegie Steel Company is still operating, on a general average, about 50 per cent. of its capacity and the Republic Iron and Steel Company less than 40 per cent. The Bessemer plant of the Republic at Youngstown is down this week. The Jones & Laughlin Steel Company and the Oliver company reinstated a few of their idle employees yesterday. Some new orders in all finished lines continue to be placed, but in small tonnages only.

Pig Iron—The pig-iron market is practically dead, no business, even in carload lots, having been placed for several days. Quotations are nominal as follows, being based on the last sales: Bessemer $17; basic, $16; No. 2 foundry, $15.50@16; gray forge, $15, all f.o.b. Valley furnaces.

Steel—There is no change in the crude-steel market. The large billet makers continue to quote $28, Pittsburg, for both bessemer and open-hearth billets, but it is believed this price was shaded on some recent sales. Sheet-bars and tin-bars remain at $29.50, delivered. Tank plate remains at 1.70c. and merchant-steel bars at 1.60c.

Sheets—A few new orders have been received, but the improvement in the sheet market is slight and prices evidently are being shaded. Black sheets are still quoted at 2.50c. and galvanized at 3.55c. for No. 28 gage.

Ferro-Manganese—The market is weaker and prices have dropped 50c. a ton or more. For spot shipment $45.50@46 a ton is quoted.

Metal Market

NEW YORK, March 18.

Gold and Silver Exports and Imports

At all United States Ports in Feb. and year.

Metal.	Exports.	Imports.	Excess.
Gold:			
Feb. 1908..	$ 1,967,597	$ 2,802,431	Imp. $ 834,834
" 1907..	1,127,059	3,329,867	" 2,202,808
Year 1908..	2,411,797	13,734,964	" 11,323,167
" 1907..	3,577,031	6,600,372	" 3,023,341
Silver:			
Feb. 1908..	4,108,774	3,409,777	Exp. $698,997
" 1907..	4,843,970	3,721,988	" 1,121,982
Year 1908..	8,256,918	7,031,651	" 1,225,267
" 1907..	9,610,935	7,379,029	" 2,231,906

Exports from the port of New York, week ended March 14: Gold, $7600, to the West Indies; silver, $780,165, chiefly to London. Imports for the week: Gold, $211,878, from Central America and the West Indies; silver, $26,495, from Mexico.

Specie holdings of the leading banks of the world March 14 are reported as below, in dollars:

	Gold.	Silver.	Total.
Ass'd New York	.....	.....	$264,496,400
England	$199,989,415	.....	199,989,415
France	550,793,310	$180,074,750	730,868,060
Germany	164,700,000	68,255,000	232,955,000
Spain	78,675,000	129,920,000	208,595,000
Netherlands	38,463,000	21,946,500	60,409,500
Belgium	20,710,000	10,355,000	31,065,000
Italy	183,165,000	23,000,000	206,165,000
Russia	579,635,000	31,630,000	611,265,000
Aust.-Hungary	232,605,000	63,200,000	295,805,000
Sweden	19,515,000	.....	19,515,000
Norway	7,330,000	.....	7,330,000
Switzerland	16,675,000	.....	16,675,000

The New York banks do not separate gold and silver. The foreign statements are from the *Commercial and Financial Chronicle* of New York.

Silver Market

SILVER AND STERLING EXCHANGE.

Mar.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.	Mar.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.
12	4.8625	55⅜	25 1/16	16	4.8610	55⅜	25 1/16
13	4.8605	55¾	25¾	17	4.8585	55¼	25⅜
14	4.8600	55¾	25⅜	18	4.8580	55⅜	25 1/16

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Messrs. Pixley & Abell report silver shipments from London to the East for the year to March 5:

	1907.	1908.	Changes.
India	£2,661,610	£1,400,538	D. £1,261,072
China	.....	496,400	I. 496,400
Straits	85,050	78,270	D. 6,780
Total	£2,746,660	£1,975,208	D. £ 771,452

Receipts for the week were £92,000 from New York. Exports were £45,000 to China, £30,713 to the Straits and £359,200 to India; £434,913 in all.

The purchases of silver by the Treasury Department for the past week were as follows: 100,000 oz. at 55.740c.; 100,000 oz. at 56.127c. per ounce.

Other Metals

Mar.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. Cts. per lb.	Spelter. New York, Cts. per lb.	Spelter. St. Louis, Cts. per lb.
12	12⅝ @12¾	12⅝ @12⅝	58⅜	29	3.65 @3.70	4.60 @4.65	4.50 @4.55
13	12⅝ @12¾	12⅝ @12⅝	58⅝	29¾	3.80 @3.85	4.60 @4.65	4.50 @4.55
14	12¾ @12⅞	12⅝ @12¾	.....	30	3.85 @3.90	4.60 @4.65	4.50 @4.55
16	12⅞ @13	12¾ @12⅞	59¼	30¾	3.85 @3.90	4.60 @4.65	4.50 @4.55
17	12⅞ @13	12¾ @12⅞	58¼	30½	3.90 @4 00	4.65 @4.70	4.55 @4.60
18	12⅞ @13⅛	12¾ @12⅞	59⅛	30½	3.90 @4.00	4.65 @4.70	4.55 @4.60

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electrolytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—The market is firm. Inquiries from domestic consumers continue good and a fair business has been done. It is noteworthy that a tendency exists to buy further ahead. There is also a good demand from Europe. Transactions are still of comparatively small volume, but there is a decidedly better tone to the market. Producers generally are well sold up and are not pressing sales. At the close we quote for Lake copper 12⅞@13⅛c., and for electrolytic copper in cakes, wirebars or ingots, 12¾@12⅞c. The average for the week at which casting copper was quoted is 12⅜@12½c.

The standard market in London, which closed last Wednesday at £57 15s. for spot and £58 2s. 6d. for three months, advanced on Thursday and closed on Friday at £58 15s. for spot and £59 2s. 6d. for three months. On Monday the market was 7s. 6d. higher. The advance led to realizations on the part of speculative holders, in consequence of which the market declined on Tuesday to £58 5s. for spot and £58 12s. 6d. for three months. However, it advanced again to £59 2s. 6d. for spot and £59 10s. for three months, at the close.

Refined and manufactured sorts we quote: English tough, £58@59; best selected, £61@62; strong sheets, £64@65.

Copper Sheets and Wire—The base price for wire is 14½c. per lb. For sheets, cold rolled or hard, 18c.; hot rolled or soft, 17c. per pound.

Tin—The advance in the London market has made further progress and large transactions took place, putting the prices at one time up to £139 10s. for spot and £137 10s. for three months. The close is somewhat easier at £138 for spot and £137 15s. for three months.

A little more interest was shown among home consumers, and good sized transactions for near-by and shipment tin have taken place. At the close the market has again become quiet, but quotations are held firmly at from 30½ @30¾c. per pound for near-by material.

Lead—Owing to a decrease in production, supplies in the hands of smelters have probably diminished. The week has witnessed an advance in price and a fair business is being done at the higher figures. The consumption of pig lead has been comparatively larger than of the other metals, but, on the other hand, the price of the metal has been so low that several of the large Western mines have been shut down for some time, so that the supplies have been decreasing. The market closed at 3.90@4c. New York.

The London market for Spanish lead declined early in the week to £13 13s. 9d., but recovered later on and closed at £13 15s. for Spanish lead, with English lead at £14.

Spelter—The market is quiet. Smelters complain that at present prices of ore and

the metal they are operating at a loss, and some further curtailments of production have taken place. The metal is being held slightly firmer, and at the close we quote 4.65@4.70c. New York, and 4.55@4.60c. St. Louis.

The European market is slightly better, good ordinaries being quoted at £21 5s. and specials at £21 12s. 6d. per ton.

Zinc Sheets—The base price is $7 per 100 lb.—less discount of 8 per cent.—f.o.b. cars at Lasalle and Peru.

Antimony—The market continues lifeless and unchanged from last week. Quotations are 8⅞@9⅛ for Cookson's, 8½@8¾ for Hallett's and 7⅞@8⅛ for ordinary brands.

Aluminum—The current price for No. 1 ingots, in ton lots, is 33c. per lb. For rods and wire, No. 0000 to 10, base price is 38c. For sheets, No. 13 to 24, B. & S. gage, base price is 40c. Tubes, 1¼ to 3½ in., base 50c. Higher prices are charged for small lots.

It is reported that offers have been made here of French aluminum at a low price. The source of these rumors is not very definite, thus far, and further investigation is needed.

Cadmium—The price is $1.25 f.o.b. Cleveland in 100-lb. lots. A higher price is asked for smaller lots.

Nickel—For large lots, New York, the chief producer quotes 45@50c. per lb. according to size and terms of sale. For small quantities, 50@65c., same delivery.

Quicksilver—New York quotations are $45 per flask for lots of 100 flasks or over, and $46 for smaller orders. San Francisco quotations are $44.50@45.50 for domestic orders; for export nominal, at about $1.50 lower. The London price is £8 5s. per flask, with £8 3s. 9d. quoted from second hands.

Platinum—A slight fluctuation in the price of platinum changed quotations this week to $27.50 per troy ounce for hard platinum; $25 for ordinary; $17.50 for scrap.

Missouri Ore Market

Joplin, Mo., March 14—The highest price paid for zinc ore was $40.50, on a base price of $37 per ton of 60 per cent. zinc., ranging down to $35 for poorer grades. The average price was $34.56. The highest price paid for lead was $50 per ton, the effort of the St. Louis Smelting and Refining Company to cut the price to $49 resulting in the Picher Lead Company taking practically all the output for next week on the basis of $50 for 80 per cent. lead. The average price for this week was $48.92 per ton.

Several important producing mines have been closed, the margin of profit being too small on existing prices. A rumor was current tonight that a movement was on foot among the mines "breaking even" and those running behind to close down mines and mills representing a weekly output estimated at 1500 tons. The stock in the bins is approximately 6000 tons, nearly half of which is not on sale on the level of prices now current.

Following are the shipments of zinc and lead from the various camps of the district for the week ending March 14:

	Zinc, lb.	Lead, lb.	Value.
Joplin	2,650,890	372,690	$56,848
Webb City-Carterville	1,994,600	563,740	47,715
Galena	1,073,080	86,740	20,903
Duenweg	876,810	114,900	18,169
Alba-Neck	396,100	37,030	8,432
Aurora	471,430	5,080	7,327
Granby	505,000	25,000	6,825
Prosperity	175,420	119,380	5,993
Quapaw	133,390	55,320	3,622
Spurgeon	199,900	23,980	3,473
Oronogo	127,320	7,660	2,568
Carthage	123,520	.....	2,346
Badger	68,080	.....	1,327
Cave Springs	62,260	.....	1,089
Carl Junction	54,270	5,620	1,086
Sarcoxie	60,760	.....	1,032
Zincite	35,380	13,730	955
Total sales	9,008,210	1,430,870	$190,710
11 weeks	91,216,070	13,123,730	$1,925,488
Zinc value, the week, $155,699; 11 weeks, $1,606,182			
Lead value, the week, 35,011; 11 weeks, 319,306			

Average ore prices in the Joplin market were, by months:

ZINC ORE AT JOPLIN.			LEAD ORE AT JOPLIN.		
Month.	1907.	1908.	Month.	1907.	1908.
January	45.84	35.56	January	83.58	46.88
February	47.11	34.92	February	84.58	49.72
March	48.66	.....	March	82.75	.....
April	48.24	.....	April	79.76	.....
May	45.98	.....	May	79.56	.....
June	44.82	.....	June	73.66	.....
July	45.79	.....	July	58.18	.....
August	43.22	.....	August	59.54	.....
September	40.11	.....	September	53.52	.....
October	39.83	.....	October	51.40	.....
November	35.19	.....	November	43.40	.....
December	30.87	.....	December	37.71	.....
Year	43.68	.....	Year	68.90	.....

Wisconsin Ore Market

Platteville, Wis., March 14—The market for both lead and zinc ores weakened again this week; $38 per ton was the highest price paid for zinc ore on a basis of $36 per ton of 60 per cent. zinc. Lead ore, 80 per cent., sold at $23 per thousand.

The downward tendency of ore prices is particularly discouraging at this time, when so many mines have just got under headway again after a prolonged shutdown; a number of others have begun pumping, with a view to resuming operations, but further decline in prices will upset such plans.

Shipments for the week ended March 14 were:

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Benton	577,280	89,860	79,800
Platteville	263,720	86,050	.....
Hazel Green	164,100	138,200	.....
Livingston	130,000	.....	.....
Linden	127,400	.....	.....
Mineral Point	93,000	43,200	.....
Total	1,355,500	357,310	79,800
Year to Mar. 14	13,964,420	976,420	79,800

The new electro-static separator has taken on several cars of ore and the results so far attained assure success to this method of separating the zinc from the iron content of concentrates.

Chemicals

New York, March 18—The general market shows no change from the lifeless condition of the first few months. Inquiries are coming in for chemicals used in the agricultural trades, but so far these have not developed into contracts.

Copper Sulphate—The demand has increased slightly, but business is still below normal. The usual spring buying from agricultural sources has not yet begun. Prices continue at $5 per 100 lb. for carloads, and $5.25 for smaller lots.

Nitrate of Soda—The market is firmer, and the demand is fairly good. The report that a syndicate composed of American and British capitalists has invested $12,000,000 in Chilean nitrate fields is generally discredited by New York dealers. Prices remain unchanged at 2.40c. for all positions of 1908; 2.37½c. for 1909; and 2.32½c. for 1910. The 96-per cent. grade sells 5c. per 100 lb. higher.

Phosphate Rock—P. C. Trenholm, Charleston, S. C., reports railroad shipments of South Carolina rock through the port of Charleston at 7128 tons in February. There were no coastwise shipments.

Mining Stocks

New York, March 18—The advance on the general stock markets continued for several days in the early part of the week, but was followed by a reaction, which was felt in all the leading stocks. It is probable that this reaction may be only temporary, but it has checked trading to some extent. The market closes with an upward turn, which came too late to judge of its permanency.

The Curb market followed the Exchange. The dealings in copper stocks were fair. The business in Cobalt and Goldfield stocks were better than for some time past.

Boston

March 17—The market for mining stocks continues firm, but is one of specialties; particularly the Butte stocks, which move along with Amalgamated Copper. The latter has had a $6 advance during the week, touching $58 for an odd lot. The close tonight was but 50c. under this. North Butte and Butte Coalition have been active at advancing prices. The former rose $4 to $54.50 followed by a $2.50 reaction and then recovering to $53.75. Butte Coalition touched $21.25, but lost part of it. Arizona Commercial and Old Dominion have also been active,

the former rising $2.75 to $20.25, with subsequent reaction to $19, and the latter $2.75 to $39, with later setback close to $37.

Utah Consolidated spurted $2.25 to $40.75. It is believed in some quarters that control of this company now rests with the Amalgamated. Mass mining report was disappointing with a deficit of $59,373 for 1907. A compromise ticket was elected at the annual meeting.

The curb has been active and strong, with some new features, principally that of the Lawson-Mexican, a Thomas W. Lawson creation. Cumberland-Ely lost an advance made a week ago on account of selling by the same interests that caused the strength.

STOCK QUOTATIONS

NEW YORK Mar. 17	
Name of Comp.	Clg.
Alaska Mine	⅛
Am.Nev.M.&P.Co.	....
Amalgamated	57¼
Anaconda	37¼
Balaklala	2
British Col. Cop.	4⅝
Buffalo Cobalt	....
Butte & London	....
Butte Coalition	20⅝
Butte Cop. & Zinc	....
Cobalt Contact	3/16
Colonial Silver	⅝
Cum. Ely Mining	8⅛
Davis Daly	4
Dominion Cop	2⅛
Douglas Copper	6½
El Rayo	1⅝
Foster Cobalt	3/16
Furnace Creek	.21
Giroux Mine	3⅜
Gold Hill	1/16
Granby, New	....
Greene Gold	¾
Greene G. & S	⅛
Greenw'r & D.Val.	.75
Guanajuato	2⅛
Guggen. Exp.	158
Hanapah	....
McKinley Dar.	.72
Micmac	4¼
Mines Co. of Am.	1⅜
Mitchell Mining	⅜
Mont.Sho. C.(New)	3½
Nev. Utah M. & S	4
Newhouse M. & S	....
Nipissing Mines	7
Old Hundred	¾
Silver Queen	1
Stewart	¾
Tennessee Cop'r.	31
Union Copper New	1/16
Utah Apex	4¼
Utah Copper	29
West Columbus	....

N. Y. INDUSTRIAL	
Am. Agri. Chem.	....
Am. Smelt. & Ref.	68⅜
Am. Sm. & Ref., pf.	....
Bethlehem Steel	....
Colo. Fuel & Iron	19⅜
Federal M. & S.,pf.	70¼
Inter. Salt	10½
National Lead	49¼
National Lead, pf.	93
Pittsburg Coal	8½
Republic I. & S.	18¼
Republic I. & S.,pf.	73
Sloss-Sheffield	50
Standard Oil	507
Tenn. C. & I.	...
U. S. Red. & Ref.	9
U. S. Steel	33⅞
U. S. Steel, pf	98⅛
Va. Car. Chem	18
Va. I. Coal & Coke	....

ST. LOUIS Mar. 14		
N. of Com.	High.	Low.
Adams	.25	.20
Am. Nettie	.04	.02
Center Cr'k	2.00	1.50
Cent. C. & C.	66.00	64.00
C.C. & C. pd.	77.00	75.00
Cent. Oil	100.00	90.00
Columbia	4.00	2.50
Con. Coal	20.00	18.00
Doe Run	130.00	120.00
Gra. Bimet.	.25	.20
St. Joe.	14.00	13.00

BOSTON Mar. 17	
Name of Comp.	Clg.
Adventure	1½
Allouez	27
Am. Zinc	24½
Arcadian	4
Atlantic	....
Bingham	....
Boston Con	15⅛
Calumet & Ariz.	104⅝
Calumet & Hecla*	625
Centennial	....
Con. Mercur	....
Copper Range*	63⅜
Daly West	8¼
Franklin	8¼
Greene-Can.	8¼
Isle Royal	21
La Salle	14¼
Mass	....
Michigan	10¾
Mohawk	50
Mont.C.&C. (new)	.75
Nevada	11½
North Butte	53⅞
Old Colony	....
Old Dominion	38⅞
Osceola	85
Parrot	18
Phoenix	1
Quincy*	85
Rhode Island	....
Santa Fe	1⅞
Shannon	11⅜
Superior	17¼
Tamarack	....
Trinity	14
United Cop., com.	....
U. S. Oil	....
U. S. Smg. & Ref.	32⅜
U.S.Sm. & Re.,pd.	40
Utah Con	40½
Victoria	....
Washington	....
Winona	5⅞
Wolverine	....
Wyandotte	....

*Ex. Div. †Ex. Rights.

BOSTON CURB	
Ahmeek	....
Ariz. Com	....
Black Mt	....
East Butte	4
Hancock Con	....
Keweenaw	....
Majestic	1⅛
Raven	1⅜
Shawmut	.47
Superior & Pitts	12⅝
Troy Man	....

LONDON Mar. 18			
Name of Com.	Clg.		
	£1	2s	6d
Dolores			
Stratton'sInd.	0	3	3
Camp Bird	0	13	3
Esperanza	1	3	9
Tomboy	1	8	9
El Oro	1	1	3
Oroville	0	11	3
Somera			
Utah Apex			
Ariz. Cop.,pfd.			
Ariz. Cop.,def.			

Cabled through Wm. P. Bonbright & Co., N.Y.

NEVADA STOCKS. March 18.

Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.	Name of Comp.	Clg.
TONOPAH STOCKS		Homestake King	.38
Belmont	1.25	Montgomery Mt.	.11
Extension	.93¾	Mont. Shoshone C.	3.62½
Golden Anchor	.03	Original Bullfrog	.03
Jim Butler	.30	Tramp Cons.	.19
MacNamara	.40	MANHAT'N STOCKS	
Midway	.62	Manhattan Cons.	.18
Montana	1.70	Manhat'n Dexter	.09
North Star	.14	Jumping Jack	.05
Tono'h Mine of N.	5.93¾	Stray Dog	.07
West End Con	.27	Indian Camp	.05
GOLDF'D STOCKS		MISCELLANEOUS	
Adams	.05½	Bonnie Clare	.20
Atlanta	.27	Golden Boulder	.08
Blue Bell	.10	Lee Gold Grotto	.04
Blue Bull	.16	Nevada Hills	2.75
Booth	.22	Nevada Smelting	1.00
Columbia Mt	.22	Pittsburgh S. Pk.	1.20
Comb. Frac	.76	Round Mt. Sphinx	.30
Cracker Jack	.08		
Dia'dfield B. B. C.	.18		
Goldfield Belmont	.15		
Goldfield Con	5.16½		
Goldfield Daisy	1.33		
Great Bend	.50		
Jumbo Extension	.41		
Katherine	.03		
Kendall	.16		
Lone Star	.10		
May Queen	.08		
Oro	.09		
Red Hill	.28		
Roanoke	.02		
Sandstorm	.28		
Silver Pick	.24		
St. Ives	.37		
Triangle	.07		
BULLFROG STOCKS			
Bullfrog Mining	.07		
Bullfrog Nat. B	.10		
Gibraltar	.10		
Gold Bar	.28		

COLO. SPRINGS Mar. 14

Name of Comp.	Clg.
Acacia	7
Black Bell	....
C. C. Con	4
Dante	7¾
Doctor Jack Pot	7
Elkton	51½
El Paso	32½
Findlay	30½
Gold Dollar	7
Gold Sovereign	....
Isabella	35⅝
Index	....
Jennie Sample	....
Jerry Johnson	8
Mary McKinney	....
Pharmacist	3½
Portland	....
Un. Gold Mines	5
Vindicator	80
Work	13¼

New Dividends

Company.	Payable.	Rate.	Amt.
Am. Ag. Chem., pfd	Apr. 15	$3.00	$544,590
Buffalo Mines	Apr. 1	0.03	27,000
Calumet & Hecla	Mar. 31	5.00	500,000
Camp Bird, Ltd	Mar. 7	0.48	840,000
Copper Range Con	Apr. 1	1.00	383,781
Dominion Coal, com	Apr. 1	1.00	150,000
Federal Smg., pfd	Mar. 16	1.75	210,000
Florence (Goldfield)	Apr. 1	0.10	125,000
Gen. Chemical, pfd	Apr. 2	1.50	150,000
Guggenheim Exp.	Apr. 7	2.50	262,500
Homestake	Mar. 25	0.50	109,200
National Lead, pfd.	Mar. 16	1.75	265,820
Nipissing	Apr. 20	0.15	180,000
North Star	Mar. 27	0.25	62,500
N. S. St. & Coal, com	Apr. 15	1.50	74,814
N. S. St. & Coal, pfd	Apr. 15	2.00	20,600
N. Y. Hond. Rosario	Mar. 21	0.10	15,000
Quincy	Mar. 23	1.50	165,000
Republic I. & S., pfd	Apr. 1	1.75	357,296
Sloss. Sheff., com	Mar. 2	1.25	125,000
Sloss. Sheff., pfd	Apr. 1	1.75	117,250
Va. Car. Chem., pfd	Apr. 15	2.00	360,000
Wolverine	Apr. 1	5.00	300,000
Work	Apr. 4	0.01	15,000

Assessments

Company.	Delinq.	Sale.	Amt.
Blackjack Con., Utah	Feb. 20	Mar. 16	$0.03
Burlington, Utah	Feb. 17	Mar. 5	0.01
Butte & Yerrington, Nev.	Mar. 25	Apr. 16	0.02
Caledonia, Nev.	Mar. 10	Apr. 1	0.10
Challenge, Nev.	Feb. 25	Mar. 17	0.10
Con. Imperial, Nev.	Mar. 11	Apr. 2	0.01
Duleek, Cal.	Mar. 6	Mar. 23	0.05
Eastern & Western, Utah	Mar. 16	Apr. 6	0.01
Exchequer, Nev.	Feb. 27	Mar. 19	0.05
Golden Fleece, Cal.	Feb. 8	Mar. 7	2.50
Hannapah, Utah	Feb. 6	Mar. 10	0.01
Jenny Lind, Cal.	Mar. 10	Mar. 26	0.02
Julia, Nev.	Feb. 24	Mar. 18	0.03
Quincy, Jr., Utah	Mar. 21	Apr. 20	0.02
Scottish Chief, Utah	Mar. 18	Apr. 10	0.01
Skylark, Utah	Mar. 27	Apr. 14	0.01
Sierra Queen, Cal.	Mar. 15	Apr. 3	0.02
Trumbull Oil, Cal.	Feb. 24	Mar. 24	0.01
Union Con., Nev.	Mar. 2	Mar. 26	0.10
Western Mines, Nev.	Mar. 16	Apr. 23	0.01½

Monthly Average Prices of Metals

AVERAGE PRICE OF SILVER

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	68.673	55.678	31.769	25.738
February	68.835	56.000	31.852	25.855
March	67.519	.....	31.325	.....
April	65.462	.....	30.253	.....
May	65.981	.....	30.471	.....
June	67.090	.....	30.893	.....
July	68.144	.....	31.366	.....
August	68.745	.....	31.637	.....
September	67.792	.....	31.313	.....
October	62.435	.....	28.863	.....
November	58.677	.....	27.154	.....
December	54.565	.....	25.362	.....
Year	65.327	.....	30.188	.....

New York, cents per fine ounce; London, pence per standard ounce.

AVERAGE PRICES OF COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.			
	1907.	1908.	1907.	1908.	1907.	1908.
January	24.404	13.726	24.825	13.901	106.739	62.386
February	24.869	12.905	25.236	13.098	107.356	58.786
March	25.065	.....	25.560	.....	106.594	.....
April	24.224	.....	25.260	.....	98.625	.....
May	24.048	.....	25.072	.....	102.375	.....
June	22.665	.....	24.140	.....	97.272	.....
July	21.130	.....	21.923	.....	95.016	.....
August	18.356	.....	19.255	.....	79.679	.....
September	15.565	.....	16.047	.....	68.375	.....
October	13.169	.....	13.551	.....	60.717	.....
November	13.391	.....	13.870	.....	61.226	.....
December	13.163	.....	13.393	.....	60.113	.....
Year	20.004	.....	20.661	.....	87.007	.....

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

AVERAGE PRICE OF TIN AT NEW YORK

Month.	1907.	1908.	Month.	1907.	1908.
January	41.548	27.380	July	41.091	.....
February	42.102	28.978	August	37.667	.....
March	41.313	.....	September	36.689	.....
April	40.938	.....	October	32.620	.....
May	43.149	.....	November	30.833	.....
June	42.120	.....	December	27.925	.....
			Av. year	38.166	.....

Prices are in cents per pound.

AVERAGE PRICE OF LEAD

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	6.000	3.691	19.828	14.469
February	6.000	3.725	19.531	14.250
March	6.000	.....	19.703	.....
April	6.000	.....	19.975	.....
May	6.000	.....	19.688	.....
June	5.760	.....	20.188	.....
July	5.288	.....	20.350	.....
August	5.250	.....	19.063	.....
September	4.813	.....	19.775	.....
October	4.750	.....	18.531	.....
November	4.376	.....	17.281	.....
December	3.658	.....	14.500	.....
Year	5.325	.....	19.034	.....

New York, cents per pound. London, pounds sterling per long ton.

AVERAGE PRICE OF SPELTER

MONTH.	New York.		St. Louis.		London.	
	1907.	1908.	1907.	1908.	1907.	1908.
January	6.732	4.513	6.582	4.363	27.125	20.563
February	6.814	4.788	6.664	4.638	25.938	20.875
March	6.837	.....	6.687	.....	26.094	.....
April	6.685	.....	6.535	.....	25.900	.....
May	6.441	.....	6.291	.....	25.563	.....
June	6.419	.....	6.269	.....	25.469	.....
July	6.072	.....	5.922	.....	23.850	.....
August	5.701	.....	5.551	.....	21.969	.....
September	5.236	.....	5.086	.....	21.050	.....
October	5.430	.....	5.280	.....	21.781	.....
November	4.925	.....	4.775	.....	21.438	.....
December	4.254	.....	4.104	.....	20.075	.....
Year	5.962	.....	5.812	.....	23.771	.....

New York and St. Louis, cents per pound. London in pounds sterling per long ton.